NASA TM-84840

Research and Technology Objectives and Plans

SUMMARY

NASA
National Aeronautics and Space Administration

FISCAL YEAR 1983 RESEARCH AND TECHNOLOGY PROGRAM

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, at the price code A07 ($14.50 domestic; $29.00 foreign).

INTRODUCTION

This publication represents the NASA research and technology program for FY 1983. It is a compilation of the "Summary" portions of each of the RTOPs (Research and Technology Objectives and Plans) used for management review and control of research currently in progress throughout NASA. The *RTOP Summary* is designed to facilitate communication and coordination among concerned technical personnel in government, in industry, and in universities. We believe also that this publication can help to expedite the technology transfer process.

The *RTOP Summary* is arranged in five sections. The first section contains citations and abstracts of the RTOPs. Following this section are four indexes: Subject, Technical Monitor, Responsible NASA Organization, and RTOP Number.

The Subject Index is an alphabetical listing of the main subject headings by which the RTOPs have been identified.

The Technical Monitor Index is an alphabetical listing of the names of individuals responsible for the RTOP.

The Responsible NASA Organization Index is an alphabetical listing of the NASA organizations which developed the RTOPs contained in the Journal.

The RTOP Number Index provides a cross-index from the RTOP number assigned by the NASA responsible organization to the corresponding accession number assigned sequentially to the RTOPs in *RTOP Summary.*

As indicated above, responsible technical monitors are listed on the RTOP summaries. Although personal exchanges of a professional nature are encouraged, your consideration is requested in avoiding excessive contact which might be disruptive to ongoing research and development.

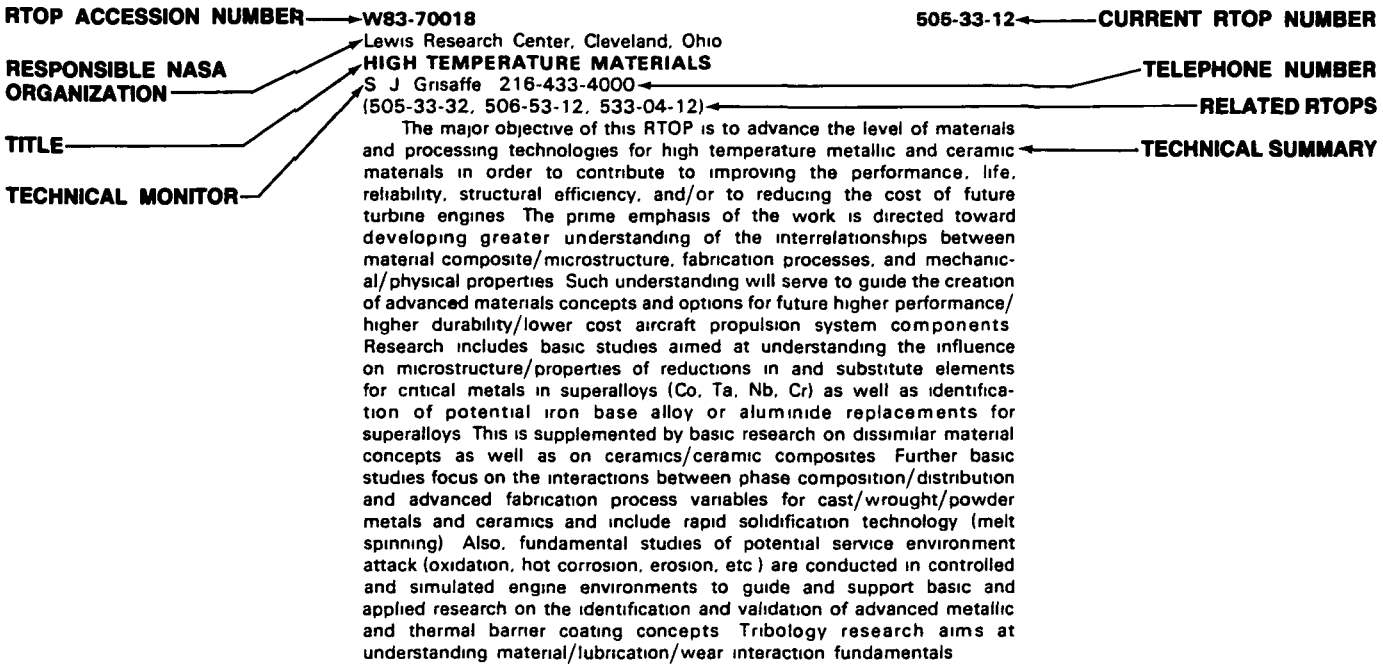
Any comments or suggestions you may have to help us evaluate or improve the effectiveness of the *RTOP Summary* would be appreciated. These should be forwarded to:

National Aeronautics and Space Administration
Office of Aeronautics and Space Technology
Washington, D.C. 20546
Attn: Edmund L. Sanchez, Acting Director
Resources and Management Systems Division (RM-3)

Jack L. Kerrebrock
Associate Administrator for
Aeronautics and Space Technology

TABLE OF CONTENTS

TYPICAL CITATION AND TECHNICAL SUMMARY



RESEARCH AND TECHNOLOGY OBJECTIVES AND PLANS

a summary

FISCAL YEAR 1983

OFFICE OF AERONAUTICS AND SPACE TECHNOLOGY

Aeronautics Research and Technology Base
Fluid and Thermal Physics Research and Technology

W83-70001 **505-31-01**
Ames Research Center, Moffett Field, Calif
COMPUTATIONAL METHODS AND APPLICATIONS IN FLUID DYNAMICS
V L Peterson 415-965-5265
(505-31-21, 506-51-11, 506-51-41, 505-37-21)

The overall objective is to develop the capability for predicting complete aerodynamic characteristics of given aircraft and missile shapes and for designing new configurations aerodynamically optimized for specific missions to a degree that preliminary concepts can be developed, evaluated, and screened with less time, cost, and wind tunnel testing New Mathematical methods, languages, and compilers will be constructed to realize the most effective use of available computer resources Computer programs will be developed to simulate turbulence and to solve complex fluid dynamics problems for the complete spectrum of flight speeds from low subsonic, transonic, to hypersonic, and for steady and unsteady, inviscid and viscous flow over two and three dimensional configurations Fundamental experiments will be performed to verify these codes and to provide the necessary turbulence models The Reynolds number domain will extend from conventional wind tunnel conditions to full scale flight conditions for present and future flight vehicles The timely transfer of advanced computational aerodynamics technology to the aerospace community will be implemented by developing and disseminating computer codes applicable to practical aerodynamic problems

W83-70002 **505-31-02**
Lewis Research Center, Cleveland, Ohio
COMPUTATIONAL FLUID DYNAMICS FOR TURBOMACHINERY
J J Adamczyk 216-433-5518
(505-40-02, 505-40-03, 505-31-03, 505-40-01)

The objective of the computational fluid mechanics program for turbomachinery is to develop understanding and modeling ability for fundamental internal flow performance, and to develop analytical and computational analyses to simulate and predict the steady and unsteady flow conditions in advanced fans and compressors, cooled turbines, and advanced propellers The analysis methods are developed into practical codes for use on NASA and industrial computers The objective of the computational fluid dynamics programs in inlets, nozzles, and high speed propellers is to advance the application of analyses into the design environment and is fourfold in nature, namely (1) develop a uniform, general and modular system of computer codes for more effective use, (2) ensure reasonable agreement between said analyses and selected sets of benchmark verification and generic validation data for reliable application, (3) develop more 'user orientation' into these codes including case running protocol for easier application, and (4) explore and develop improved numerical methodology as applied to advanced vector computers for more cost effective operation

W83-70003 **505-31-03**
Langley Research Center, Hampton, Va
COMPUTATIONAL AND ANALYTICAL FLUID DYNAMICS
P J Bobbitt 804-827-3285
(505-31-13, 505-31-23, 505-31-53)

The purpose of this research is to provide the fundamental computational methods required for calculating complete aerodynamic characteristics of complex aircraft shapes and for optimizing aircraft shapes for a given mission The primary emphasis will be basic research in numerical and anaytical methods coupled with large-scale computers Research includes viscous and inviscid flow methods for all speed ranges The main interest is in large, nonlinear problems, studies include acceleration of iterative methods for large systems of finite difference equations using processor computers such as CYBER 203 and CRAY

W83-70004 **505-31-11**
Ames Research Center, Moffett Field, Calif
VISCOUS FLOWS
J D Murphy 415-965-5856

The objective is to acquire a sufficient understanding of viscous flows to permit the use of rational analysis methods in the design process To support the above, detailed experimental data and economical computational schemes for turbulence modeling, data interpretation, and the development of design tools are required Emphasis is placed on obtaining experimental data in terms of both mean flow quantities and turbulence parameters using pressure instrumentation, hot wires, and optical devices in the 6- by 6-foot, 2- by 2-foot, and 7- by 10-foot wind tunnels Such data will be used to guide the development of mathematical models for turbulent structures These mathematical models will subsequently be used to develop fast, efficient methods for the prediction of both attached and separated turbulent flows

W83-70005 **505-31-13**
Langley Research Center, Hampton, Va
VISCOUS DRAG REDUCTION AND CONTROL
R V Harris, Jr 804-827-2658

Research to significantly improve our ability to predict and control the behavior of turbulent shear flows including boundary layers, free shear layers and recirculating/vortex flows will be performed including theoretical and experimental research to (1) reduce turbulent skin friction drag, (2) control stream disturbances in supersonic and hypersonic tunnels, (3) determine sensitivities of boundary layer transition process to stream disturbances, and (4) improve understanding of physics/structure of turbulent shear flows and turbulence modeling for computational fluid dynamics Drag reduction research investigates non-planar geometries such as riblets, large eddy breakup devices, convex curvature, long wavelength surfaces, Emmons spot alteration, fuselage relaminarization, and ion wind concepts, primarily for eventual CTOL transport application Free stream disturbance research develops stagnation chamber treatments and laminar flow and rapid expansion nozzles to improve validity of wind tunnel measurements, especially for data where transition and flow separation are present Detailed boundary layer transition studies with controlled input disturbances determine sensitivity of transition process to operational factors such as engine noise and surface irregularities Detailed experiments using hot wires, LV/Raman, Rayleigh scattering, and resonant Doppler systems provide data for development and validation of turbulence closure models in three-dimensional boundary layers, three-dimensional free mixing, corner/recirculating/vortex flows, and shock-turbulence interaction/amplification

W83-70006 **505-31-15**
Jet Propulsion Laboratory, Pasadena, Calif
BOUNDARY-LAYER STABILITY AND TRANSITION RESEARCH
L M Mack 213-354-2138

Knowledge of where laminar-turbulent transition will occur is important for accurate drag calculations, and a significant reduction in total drag is possible if transition can be delayed by passive or active means At present it is not possible to make a rational prediction of and where transition will occur because the relationship between transition and the disturbances that cause it is not known It is the purpose of the work described in this RTOP to investigate experimentally and theoretically the production of instability waves by external disturbance sources (receptivity problem), and the propagation of the resultant wave packets and wave trains in the boundary layer The experimental program consists of two parts The first part, a wave propagation experiment, will measure the wave trains and wave packets formed by continuous and pulsed point and line sources in planar and axisymmetric boundary layers The second part, a receptivity experiment, will seek the mechanisms by which instability waves are produced by freestream turbulence, and relate the initial amplitudes and phases of the instability waves to the properties of the turbulence The theoretical program is closely coordinated with the experiments The point source initial-value problems will be solved both by direct numerical integration and by the method of steepest descent as generalized by Gaster for growing boundary layers Use of the Gaster eigenvalue series will make it feasible to compute the large numbers of eigenvalues that are needed to construct the wave patterns The wave motion downstream of line sources will be obtained from the superposition of point source solutions A model for the receptivity problem will be developd on the basis of the experimental findings The long term objective is to combine the results of the wave propagation and receptivity investigation to arrive at a rational method for the prediction of transition

W83-70007 **505-31-21**
Ames Research Center, Moffett Field, Calif
EXPERIMENTAL/THEORETICAL AERODYNAMICS
L L Presley 415-965-5851

The objective of this research is to expand the aerodynamic technology base and provide a basic understanding of the aerodynamic flow fields about complete aircraft configurations, as well as individual components through the angle-of-attack range and from subsonic through supersonic Mach numbers This includes ground based testing, flight experiments, and the application and development of theoretical prediction methods Elements of this research are to (1) develop a computer structure for theory/experiment integration, (2) develop an advanced panel code (PAN AIR), (3) develop a transonic wing-body-tail code and three-dimensional transonic wing design codes, (4) develop prediction techniques for oscillating airfoil flows, (5) conduct investigations of three-dimensional bodies at high angles-of-attack, (6) measure coherent structures in turbulent separated flows, (7) develop a subsonic aerodynamic analysis code (VSAERO), (8) conduct experiment and analytical studies of aircraft trailing wake vortex flows, and (9) conduct flight experiments which are complementary to the analytical and wind tunnel research programs

W83-70008 **505-31-23**
Langley Research Center, Hampton, Va
EXPERIMENTAL/APPLIED AERODYNAMICS
P J Bobbitt 804-827-2961
(505-31-53)

The objective of this research is to provide the fundamental data base needed for the efficient design of advanced aircraft and for the development of aerodynamic prediction techniques In-house, contract and grant research will be used to advance the state-of-the-art with regard to (1) advanced airfoils for fixed- and rotating-wing aircraft, (2) cruise and maneuver aerodynamics for the design of wings and generalized aircraft configurations, (3) boundary layer growth disturbances, (4) efficient aerodynamic design procedures for supersonic/hypersonic vehicles (5) understanding of aircraft wake vortex flows and high lift design technology

W83-70009 **505-31-32**
Lewis Research Center, Cleveland, Ohio
FLUID MECHANICS OF TURBOMACHINERY/LEWIS
L D Nichols 216-433-6906
(505-40-12)

The aim of this research is to develop an understanding of fluid mechanics of turbomachinery to improve performance and reduce design costs Increased emphasis is placed on experiments to understand internal flows and analysis codes to improve turbomachinery design systems The information will be used to improve the efficiency, operating range, distortion tolerance, durability and reliability and to reduce weight, volume, and cost of the turbomachinery systems Understanding of the unsteady aerodynamic forces under various flutter conditions will be obtained and codes developed and verified to be able to avoid the occurrence of flutter and minimize the effects of aerodynamic forcing terms Understanding of the steady and unsteady aerodynamic forces pertinent to noise generating mechanisms will be developed based upon experimental results and models validated to predict noise generation and provide a means for its reduction Understanding of the effects of exciting fluid mechanic instabilities which occur in turbomachinery will be developed to determine the extent which they may be exploited to influence turbomachinery performance

W83-70010 **505-31-33**
Langley Research Center, Hampton, Va
AEROACOUSTICS RESEARCH
R C Goetz 804-827-2042
(505-33-53 505-35-13, 505-42-23, 532-06-13)

The objective of this aeroacoustics research is understanding and predicting the generation and propagation of noise due to fluid flows associated with aircraft propulsion systems and then reducing or controlling the noise with minimum weight, performance, and economic penalties Analytical, computational, and experimental approaches are included in research that is conducted in-house and by grant and contract Improved understanding of the mechanisms by which fluid flows generate noise is sought, and theories and validating data bases for accurate prediction and noise reduction are developed The experimental portion of the program emphasizes model scale laboratory studies under controlled conditions, supplemented by flight tests where appropriate The problem areas upon which the program is focused are subsonic and supersonic jet exhaust noise, flight effects on turbomachinery noise, duct acoustics, and atmospheric propagation

W83-70011 **505-31-41**
Ames Research Center, Moffett Field, Calif
COMPUTATIONAL FLAME RADIATION RESEARCH
R L Jaffe 415-965-6458

The objectives are to provide an in-depth, theoretical understanding of both combustion processes and spectroscopic techniques used for non-intrusive, laser-based flame diagnostic measurements The research will be coordinated with several experimental programs which are not part of the RTOP The approach will utilize first principles calculations of the fundamental properties, if they are not well known, of molecules which have important roles in combustion processess These data will be coupled with the results from numerical flame structure models to produce synthetic spectra which can be compared to experimental flame spectra taken under identical conditions Significant differences between the experimental and theoretical spectra would indicate deficiencies in the numerical model which would then be improved until agreement is attained Consequently, this research will lead to the establishment of a validated combustion model which is capable of reliably predicting flame properties The theoretical molecular property data will also be used to synthesize cross sections for spectroscopic transitions which can be used for diagnostic measurements of flame temperature and composition This research will help identify new non-intrusive analytical techniques for combustion experiments and add to the effectiveness of existing diagnostic methods

W83-70012 **505-31-42**
Lewis Research Center, Cleveland, Ohio
BURNING FUNDAMENTALS & HEAT TRANSFER
R A Rudey 216-433-6625
(505-40-22)

The objective of the Combustion and Heat Transfer Research Program is to provide technology for advanced combustion, turbine and aircraft fuel systems for future civil and military applications aimed at improving performance, durability, and reliability while achieving fuel flexibility and reduced emissions by establishing a more complete and basic understanding of fundamental combustion and heat transfer phenomena typical of gas turbine engines and to support the development of advanced computational techniques for accurately characterizing the governing aerothermodynamic process The effort is focused on (1) developing a fundamental knowledge and understanding of the characteristics and effects of potential alternative fuels (2) achieving a basic understanding and analytical representation of the fundamental aerodynamic and chemical kinetic phenomena governing the combustion process, (3) developing analytical models for predicting the internal aerothermodynamic performance of combustors, turbines, and fuel systems, and (4) developing analytical models for predicting thermodynamic and transport properties and chemical reaction rates for hydrocarbon fuels The program includes both fundamental and applied research activities conducted in-house, under grants to universities, and under contracts to industry Overall coordination with other government agencies, such as DOD,

DOE, DOT, EPA, and with industry is maintained in order to provide the proper direction and scope to the program

W83-70013 **505-31-51**
Ames Research Center, Moffett Field, Calif
TEST METHODS AND INSTRUMENTATION
G Lee 415-965-5861

The general objective of this research is to provide the technology for increased aerodynamic experimental research capability required to improve prediction of performance and flight characteristics of conceptual or new aircraft designs and the exploration of advanced aerodynamic concepts This includes both ground-based and flight test capability improvements Flow quality, measurement of model attitude and deformation, minimization or elimination of wind tunnel wall constraint effects, and means for simulating higher Reynolds number flows will be investigated analytically and experimentally to improve the quality of test results To improve the state-of-the-art in non-intrusive measurement capability, advanced laser velocimeter and holographic interferometric instrumentation systems will be developed to obtain fundamental fluid mechanic measurments such as mean velocities, turbulence intensities, densities, and Reynolds stress components Infrared camera technology will be explored as a means of locating shock waves and regions of separation on wind tunnel models To improve the state-of-the-art of flight test techniques and flight measurement capability, development efforts are planned which include an air data/inertially based integrated sensor system, a miniaturized multichannel pressure sensor system, a high accuracy fuel flow meter, and hot wire/film sensor signal conditioning system

W83-70014 **505-31-52**
Lewis Research Center, Cleveland, Ohio
PROPULSION INSTRUMENTATION
N C Wenger 216-433-6646
(505-40-52)

The objective of this RTOP is to develop sensors and measurement systems that have application in studies of fundamental phenomena, in component research and development, and in full-scale engine experimentation and testing Part of the effort is focused on developing miniature minimally intrusive sensors for measuring temperature, heat flux, and strain in a wide variety of applications The balance of the effort is directed at research on nonintrusive measurement systems, usually employing lasers, for the measurements of strain, gas flows, combustion gas species and temperature, and smoke parameters This effort is closely coordinated with the development of bench mark experiments where critical measurements are required to determine the validity and accuracy of various types of fluid mechanic, combustion, and structural models and computer codes that are currently under development

W83-70015 **505-31-53**
Langley Research Center, Hampton, Va
EXPERIMENTAL TEST TECHNIQUES
P J Bobbitt 804-827-2961

The technical objective is to provide the technology for increased ground based aerodynamic experimental research capability and to develop the specific test technology required to fully exploit the unique capabilities of the new pressurized cryogenic wind tunnels in the performance of research and development studies related to advanced aerodynamic test concepts at full scale Reynolds numbers This objective will be accomplished utilizing in-house, contract, and grant research to (1) extend development of cryogenic technology and full-scale Reynolds number test techniques to insure maximum utilization of the unique research and development capabilities of the new Langley National Transonic Facility, (2) continue development of technology required for sound engineering of models for the high pressure cryogenic environment including establishment of model criteria, (3) advance the state-of-the-art of instrumentation techniques and provide instrumentation capable of operating over a wide temperature range with emphasis on minimizing measurement error and time required for data collection, (4) advance the state-of-the-art of experimental methods including transonic tunnel wall interference effects and magnetic suspension and balance systems, and (5) provide operational support in terms of liquid nitrogen and staffing for calibration of the National Transonic Facility

W83-70016 **505-31-83**
Langley Research Center, Hampton, Va
MATHEMATICS FOR ENGINEERING AND SCIENCE
Robert H Tolson 804-827-2664

The objective of this RTOP is to provide new mathematical methods and models and apply these to understanding aerospace phenomena, improving computer simulation, and supporting advanced developments The research is carried out by a combination of in-house efforts, university research grants, and the continuing operation of the Institute for Computer Applications in Science and Engineering (ICASE) located at the Langley Research Center The in-house and grant efforts include research dealing with numerical solutions of differential and algebraic systems, data analysis, computer graphics, symbolic and algebraic manipulation, data base management, programming languages, microprocessor software, and software engineering The broad research areas pursued in ICASE include numerical analysis with particular emphasis on the development and analysis of basic numerical algorithms, computational research in engineering and science in selected research areas of concern to the Langley Research Center, including fluid dynamics, structural analysis, acoustics, guidance and control, and other appropriate areas, and computer systems and software, such as advanced computers, microprocessors, and computer graphics

Materials and Structures Research and Technology

W83-70017 **505-33-10**
National Aeronautics and Space Administration, Washington, D C
RESEARCH IN ADVANCED MATERIAL CONCEPTS FOR AERONAUTICS
Michael A Greenfield 202-755-3277

The objective is to conduct advanced fundamental research on advanced material concepts for aeronautics The research will be performed by educational institutions utilizing interdisciplinary capabilities in materials engineering, mechanical engineering, aeronautical engineering, civil engineering, and chemistry Research projects will involve ceramic and composite materials characterization, structural integrity, structural analysis and design, processing techniques, and systems applications Advisory services to guide R and D in advanced aerospace materials and structures are provided by the National Materials Advisory Board, a unit of the Division of Engineering, National Research Council, National Academy of Sciences, and National Academy of Engineering

W83-70018 **505-33-12**
Lewis Research Center, Cleveland, Ohio
HIGH TEMPERATURE MATERIALS
S J Grisaffe 216-433-4000
(505-33-32, 506-53-12, 533-04-12)

The major objective of this RTOP is to advance the level of materials and processing technologies for high temperature metallic and ceramic materials in order to contribute to improving the performance, life, reliability, structural efficiency, and/or to reducing the cost of future turbine engines The prime emphasis of the work is directed toward developing greater understanding of the interrelationships between material composite/microstructure, fabrication processes, and mechanical/physical properties Such understanding will serve to guide the creation of advanced materials concepts and options for future higher performance/higher durability/lower cost aircraft propulsion system components Research includes basic studies aimed at understanding the influence on microstructure/properties of reductions in and substitute elements for critical metals in superalloys (Co, Ta, Nb, Cr) as well as identification of potential iron base alloy or aluminide replacements for superalloys This is supplemented by basic research on dissimilar material concepts as well as on ceramics/ceramic composites Further basic studies focus on the interactions between phase composition/distribution and advanced fabrication process variables for cast/wrought/powder metals and ceramics and include rapid solidification technology (melt spinning) Also, fundamental studies of potential service environment attack (oxidation, hot corrosion, erosion, etc) are conducted in controlled and simulated engine environments to guide and support basic and applied research on the identification and validation of advanced metallic and thermal barrier coating concepts Tribology research aims at understanding material/lubrication/wear interaction fundamentals

W83-70019 **505-33-13**
Langley Research Center, Hampton, Va
ADVANCED STRUCTURAL ALLOYS
R C Goetz 804-827-2042
(505-33-23, 505-43-43)

The objectives of this research are focused on understanding the metallurgical structure/mechanical property relationships characteristic of advanced structural alloys This understanding is expected to provide a basis for new or improved concepts to achieve more efficient structural alloys for future aircraft applications Current research includes (1) fundamental studies of the structure/property relationships in advanced powder metallurgy (PM) aluminum alloys as they relate either to alloy chemistry, thermomechanical treatments, or aging behavior, and (2) the

development of new/improved processing methods to provide a basis to achieve more efficient structural shapes Research in advanced PM aluminum alloys will include optimizing powder processing techniques, alloy chemistry, and thermomechanical treatments based on a fundamental understanding of the metallurgical features desirable for high performance applications Research in processing technology will emphasize superplastic forming (SPF) of advanced aluminum alloys to achieve unique and highly efficient structural shapes, SPF effects on microstructure and mechanical properties will be characterized Adoptability of the SPF process to advanced PM aluminum alloys will be explored

W83-70020 **505-33-21**
Ames Research Center, Moffett Field, Calif
LIFE PREDICTON. FATIGUE DAMAGE AND ENVIRONMENTAL EFFECTS IN METALS AND COMPOSITES
H G Nelson 415-965-6137

A combined experimental and analytical program will continue in an effort to characterize and better understand the fatigue and fracture behavior of both metallic and composite (graphite/epoxy) materials used or anticipated to be used in airframe structures Additionally, the knowledge will be applied where practicable, to help solve existing engineering problems and to improve life prediction procedures of real aerospace structures For composite materials, a modified time-temperature super position approach is used to establish correspondence between stress, moisture, temperature, and time as these variables influence the durability of complex graphite/epoxy laminates It is our aim to develop the methodology required to obtain accurate constitutive relationships such that improved accelerated test procedures and life prediction techniques can be applied to real aerospace composite structures which behave in a viscoelastic manner Areas of interest include all types of mechanical and physical behavior including moisture absorption and physical aging In all cases the ranges of applicability of this mechanics approach are being established through relevant mechanistic investigations For metallic materials, crack initiation and subcritical crack growth stages of fracture are being characterized using a fracture mechanics approach Our primary objective is to understand the influences of the chemical environment on fracture behavior in order that we may predict the stress corrosion and corrosion fatigue behavior of aerospace structural materials including advanced P/M aluminum alloys Considerable emphasis is placed upon understanding the kinetic aspects of embrittlement and in particular the importance of surfaces and surface reactions

W83-70021 **505-33-22**
Lewis Research Center, Cleveland, Ohio
LIFE PREDICTION FOR ENGINE MATERIALS
Marvin H Hirschberg 216-433-4000
(533-04-12)

The major objective is to obtain a better understanding and description of the creep-fatigue viscoplastic flow and fracture of advanced materials systems The approach is to formulate and verify practical concepts involving cumulative damage assessment and life prediction methods that account for interactive effects on the crack initiation, crack propagation, and fracture of structural components when subjected to complex time dependent patterns of temperatures and cyclic loads

W83-70022 **505-33-23**
Langley Research Center, Hampton, Va
LIFE PREDICTION FOR STRUCTURAL MATERIALS
R C Goetz 804-827-2042
(505-33-13, 505-33-33, 506-53-23)

The objectives of this research are to understand the fatigue and fracture behavior of experimental and engineering materials and to develop reliable life prediction techniques that are applicable to the use of these materials in aircraft structures Formulation of a theoretical framework for life prediction and experimental validation of the theoretical concepts involved form a major part of this research focus Characterization of the integrity of structural materials by nondestructive techniques is also included The nondestructive materials research involves both theoretical modeling and experimental verification of advanced ultrasonic/acoustic phenomena as related to understanding fundamental material properties and behavior under complex 'oads Research in fatigue and fracture includes structural alloys as well as thick-section, polymeric composites In depth analyses of the fracture and crack growth processes will be conducted and comparisons made to validate and extend the reliability of current life prediction models Nondestructive materials research will focus on providing a scientific basis for quantitative ultrasonic analysis of the integrity and properties of composites and metals Precision measurement techniques to determine the physical mechanisms of materials behavior such as the mechanics of impact damage in composites will constitute a significant part of the nondestructive materials research

W83-70023 **505-33-31**
Ames Research Center, Moffett Field, Calif
FIRE RESISTANT COMPOSITES
J A Parker 415-965-5225
(505-45-11)

The objective is to develop fiber resin composite materials which can be processed by commercial methods for primary and secondary composite aircraft structures which are environmentally stable, mechanically reliable, and cost effective Composites with improved toughness, fire resistance and processing parameters are the objectives for candidate polymers and fibers Determination of interrelationships of molecular structure with the desired properties will include the coding and cataloging of the chemical structures of important matrix resin systems and establishing a workable polymer science data base Low or strain free composites will be developed by working with those oligomer systems capable of low temperature, approximately 175 F, gelation and curing at 350 F or less Liquid or low melt viscosity oligomers will be developed from aromatic bismaleimides (BMI), polystyrylpyridines (PSP), and divinyl or diallyl monomers Polymer blends (e g , rubber toughening) will also be studied Carbon fibers with new sizing compounds with subsequent combination of different arrays of fibers and lay-up geometries to reduce impact damage will also be investigated Engineering tests include DMA, shear, impact, torque, tensile, and flammability Possible matrix resins for high temperature applications are phosphorylated BMI, polyphthalocyanines, aspartimides, and PSP, evaluation of these systems will be completed Experimental and theoretical studies on polymers exhibiting electrical conductivity are required, as are quantum chemistry and other computational methods applied to various polymers and their model compounds

W83-70024 **505-33-32**
Lewis Research Center, Cleveland, Ohio
HIGH TEMPERATURE ENGINE COMPOSITES
H B Probst 216-433-4000
(505-33-12)

The overall objective of this research is to identify and evolve composite materials and processing technology with potential for aero propulsion components having lower weight, higher use temperature, higher strength, reduced cost, and greater reliability A wide range of matrix materials is under investigation including polymers, metals, and ceramics In the area of polymer matrix composites, emphasis is placed on synthesis of high temperature (to 370 C), processible resins, resins of improved toughness, and on development of chemical characterization methodology that supports understanding of polymerization and in-service reactions High temperature adhesives are also being addressed In metal matrix composites, emphasis is placed on improving key properties of high temperature composite systems as well as on understanding how these materials fail and degrade so as to overcome their deficiencies In ceramic matrix composites, studies are devoted to polymeric precursors which will give high temperature ceramic matrices Micromechanics of composite systems are under study to eventually develop a modeling capability to predict strength and toughness

W83-70025 **505-33-33**
Langley Research Center, Hampton, Va
COMPOSITES FOR AIRFRAME STRUCTURES
R C Goetz 804-827-2042
(505-33-23, 506-53-23)

The objective is to achieve the full weight reduction potential of highly loaded composite structures The approach is to improve matrix properties, damage tolerant concepts, analytical predictive methods, and understanding of aging effects Structural resins and adhesives with improved toughness, moisture resistance, processability, and thermal performance will be synthesized Fundamental factors which control toughness and damage tolerance in resins and composites will be determined Impact damage and residual strength will be measured and modeled mathematically The effectiveness of bolted composite joints and woven buffer strips will be studied Using advanced structural concepts and design methods, flat, curved and stiffened structures will be made and tested in compression, tension, combined loads, and after damage Analytical methods will be developed to predict properties Long-term durability under expected service environments will be studied using ground based and flight service exposure Predictive analytical methods for environmental effects will be developed with emphasis on verification of accelerated test methods Analyses for describing the nonlinear behavior of structures including postbuckling and ultimate strength will be developed Processing methods for new resin systems will be established with emphasis on economics and consistent quality Resin rheology and cure mechanics studies will be used as the basis for developing cure processes

W83-70026 **505-33-41**
Ames Research Center, Moffett Field, Calif
FLIGHT LOADS ANALYSIS
A L Carter 805-258-3311

This RTOP has four primary purposes (1) to study unsteady aerodynamic loads and flutter suppression at transonic speeds using OAST research flights (2) to study airload and Flight Deflection Measurement System techniques on large, flexible aircraft, (3) correlation of flight measured and predicted buffet for the AFTI/F-111 aircraft, (4) to develop and verify flight loads analysis methods for flight testing applications

W83-70027 **505-33-42**
Lewis Research Center, Cleveland, Ohio
ENGINE DYNAMICS AND AEROELASTICITY
L Berke 216-433-4000
(505-33-52)

The objective of this program is to develop improved methods of analyzing the structural dynamics and aeroelasticity of aircraft turbine engines so that the structural design of an engine can be more on design calculations and less on testing and rebuild procedures New methods will be developed under this program which can take advantage of increased computer capabilities The approach will be to develop mathematical models of the engine and its structural components These models will take into account the interactions between components including those at frictional interfaces, and provide a more comprehensive treatment of the internal degrees of freedom of these components Steady state and transient situations, such as blade loss, will be addressed More thorough methods of predicting aeroelastic stability and forced response will be developed

W83-70028 **505-33-43**
Langley Research Center, Hampton, Va
LOADS AND AEROELASTICITY
R C Goetz 804-827-2042
(533-02-73)

The objective is to develop and validate improved methods for analytically determining loads, structural response, and structural stability of aerospace systems considering the dynamic and aeroelastic characteristics of the systems and structural interactions with flight control sub-systems, and to use these methods in the development and evaluation of techniques for eliminating or minimizing flutter, buffet, and other undesirable response phenomena, and for the enhancement of performance, ride quality, and service life Research will be conducted to provide more accurate unsteady aerodynamic theories, particularly in the transonic range Advanced aeroelastic analysis methods will be evaluated and validated by both wind tunnel tests and flight tests using the DAST concept (Drones for Aerodynamic and Structural Testing) Emphasis will be on measurements of transonic aerodynamic loads, and flight validation of active control systems for load alleviation and flutter suppression A decoupler-pylon concept for wing store flutter suppression will be evaluated in flight tests on a fighter airplane Basic wind tunnel flutter studies will be used to gain a better understanding of the flutter characteristics of advanced aerodynamic configurations The obsolete dynamic data acquisition system of the LaRC Transonic Dynamics Tunnel will be replaced with modern hardware and appropriate software to allow efficient operation of the tunnel

W83-70029 **505-33-53**
Langley Research Center, Hampton, Va
ADVANCED STRUCTURAL ANALYSIS METHODS
R C Goetz 804-827-2042

The objective is to understand the behavior of composite structures under crash loadings In-house test procedures will be developed and tests conducted to measure the response of composite structural components under crash conditions Test articles requiring special tooling will be fabricated under contract Preparations for full-scale crash test of a B-720 aircraft will continue in cooperation with Ames (Dryden) and FAA Structural analysis and sizing methods will be developed for aerospace structures Particular attention will be paid to nonlinear behavior such as postbuckling phenomena and ultimate strength of composite structures An interdisciplinar research team (PICASSO) will continue development of integrated analysis and synthesis methods and associated computer software Large-scale optimization of a transport aircraft wing for fuel efficiency will be pursued in cooperation with Lockheed-California Company The research will also (1) develop and evaluate structural concepts and thermal management techniques for application to airframes and engines of aircraft which cruise in supersonic to hypersonic regime, (2) develop and verify practical concepts for alternate Mach numbers and oxygen enrichment in 8' High Temperature Structure Tunnel, and (3) develop improved methods of analysis for noise in aircraft cabins and techniques for minimizing noise transmission to enhance ride quality The research encompasses in-house laboratory studies and out-of-house analysis and experiments on aircraft and model cylinders

Controls and Guidance Research and Technology

W83-70030 **505-34-01**
Ames Research Center, Moffett Field, Calif
FLIGHT CONTROL CONCEPTS AND RELIABILITY ENHANCEMENT
J A Franklin 415-965-5009
(505-34-11, 505-34-03, 505-36-11, 505-42-11 532-06-11, 505-34-33)

Research in advanced control technology will be pursued to develop the technology base for design of reliable, flight crucial control systems for aircraft and aerospace craft that provided improved operational capabilities over these vehicles flight envelopes Analytical studies will be conducted to investigate concepts and methodology Ground based simulation and flight experiments will be carried out to substantiate the methodology Nonlinear inverse system concepts and optimal control methods will be employed for vehicles that exhibit significant aerodynamic and kinematic nonlinearities and control redundancy Fly-by-wire control, fault tolerant microcomputer and actuation system concepts will be explored for the purpose of enhancing control reliability Flying qualities design requirements for super augmented aircraft will be defined and automated control concepts developed such as for air combat missions University grants will be awarded to support promising research in the field and to keep NASA abreast of new advances in control theory pertinent to analysis and synthesis of reliable flight control systems

W83-70031 **505-34-02**
Lewis Research Center, Cleveland, Ohio
CONTROL THEORY AND METHODOLOGY
F Teren 216-433-4000

The objective is to provide an improved technology base for future engine control system development through the development of advanced multivariable control theory and methodology, and reliable fault tolerant distributed controls Multivariable control design techniques are developed and applied using time and frequency domain methods Sensor failure detection, isolation and accommodation algorithms are developed for single and multiple engine applications The latest VLSI circuitry technologies are utilized in multiple processor fault tolerant full-authority electronic propulsion control architectures Both software and hardware technologies are pursued

W83-70032 **505-34-03**
Langley Research Center, Hampton, Va
AIRCRAFT CONTROLS· THEORY AND APPLICATIONS
J R Elliott 804-827-4681
(505-34-01, 505-34-02, 505-35-02, 505-45-03)

NASA has a primary national responsibility and plays a major role in the area of flight control research and technology innovations and development The design goal of fuel efficient, high performance aircraft of the future is resulting in increased reliance on controls technology This trend demands a continuing activity of investigations, development, and validation of advanced stability, control, and guidance concepts which will permit the control system designer to adequately cope with the increasingly complex demands of modern aircraft control system designs The objectives of this RTOP are to develop and validate advanced theoretical concepts for control of aircraft and their trajectories, to develop and validate methodology for the integrated design of advanced flight control systems, and to develop guidelines and criteria for designing full-authority control systems for highly augmented aircraft The research to be conducted is an effort towards fulfilling the need to maintain the U S in a competitive position in the stability, control, and guidance disciplines applied to highly augmented civil and military aircraft Advanced control theory and system identification procedures, computer program development and techniques for computer aided aircraft design processes, mathematical modeling procedures and analysis/synthesis procedures for flexible aircraft with active controls, and aircraft flying qualities and control system design criteria research will be pursued through in-house, contract, and grant studies with leading specialists Research activities will encompass studies of a theoretical nature, validation studies through simulation and flight test studies

W83-70033 **505-34-11**
Ames Research Center, Moffett Field, Calif
ADVANCED CONTROLS AND GUIDANCE
D G Denery 415-965-5427
(505-34-01, 532-01-11 532-06-11, 505-45-11, 533-02-51)

The objective of this research is to develop a technology base for the design, validation, and assessment of flight crucial controls and to develop advanced guidance concepts for both civil and military missions The work will be accomplished within six tasks (1) the development, evaluation, and flight test of advanced flight control techniques utilizing the F-8 flight (2) the development and evaluation of advanced verification and validation tools applicable to digital flight control systems, (3) the development of theory and techniques to design and evaluate advanced flight path guidance concepts that are compatible with the future National Airspace System, (4) the development of air traffic control flow management algorithms that exploit the potential of both advanced on-board guidance and ground computers to increase capacity and efficiency of the National Airspace System, (5) the development of theory and techniques to design and evaluate flight path guidance systems for military missions including automated air combat, and (6) the development and evaluation of advanced guidance concepts for landing on small ships

W83-70034 **505-34-13**
Langley Research Center, Hampton, Va
ADVANCED NAVIGATION, GUIDANCE AND CONTROLS TECHNOLOGY
H Milton Holt 804-827-3681
(505-34-23 505-45-03, 505-37-13 505-45-33, 505-34-03, 505-37-23, 505-43-13)

Aircraft of the 1990 to 2000 time period can be more efficient and profitable as a result of new technology advances The acceptance of those advances can be accelerated by reducing the risk of the new technology The objective of this effort is to develop a technology base for the design, validation, assessment of flight-crucial controls and to develop advanced guidance concepts and crew station interface devices for improving aircraft flight path guidance The approach is to develop the methodology for fully integrated flight-crucial controls and guidance functions, identify candidate system architectural concepts, establish a creditable validation process for advanced digital system designs through the development of new assessment methods, emulation/simulation techniques, and physical testing techniques, develop theories and techniques to design and evaluate advanced flight path guidance systems, develop advanced display concepts and information input/output techniques, and investigate lightning environmental effects

W83-70035 **505-34-23**
Langley Research Center, Hampton, Va
AIRLAB OPERATIONS
D G Holden 804-827-3681
(505-34-13)

The objectives are to operate, maintain, and enhance the role of AIRLAB to study, evaluate, and demonstrate the safety, reliability, and performance of fault-tolerant electronic systems for future aerospace applications, maximize the utility and operating time of AIRLAB equipment by providing hardware and software maintenance support in an efficient and timely manner, and implement new or improved hardware and support software to enhance AIRLAB capabilities, improve ease of use, and increase productivity

Human Factors Research and Technology

W83-70036 **505-35-01**
Ames Research Center, Moffett Field, Calif
HUMAN FACTORS FACILITIES OPERATIONS
H P Klein 415-965-5094
(505-35-21, 505-35-31, 505-42-41)

This RTOP provides for the operation, maintenance modification, and upgrade of the research facilities of the Man-Vehicle Systems Research Division at Ames Research Center The division conducts a variety of human factors research programs fo NASA, DoD, FAA, industry, and other Government agencies in the areas of advanced concepts of flight management systems, human factors in aviation safety, helicopter/VTOL human factors, workload/performance measurement, perception, and simulation and training technology This research requires the utilization of part-task and part-system experiment areas, computers, and cockpit simulators in N239 and N239A and the full-system/full-mission flight simulators in N257 (the Man-Vehicle Systems Research Facility) Complete facility operations staff including computer systems and data analysis programmers, computer operators, computer and othe special purpose electronic and electro-mechanical equipment maintenance technicians, experimental device fabrication technicians, simulation operation engineers and technicians, and other required facility services such as janitorial support, and general building maintenance are provided Also covered by this RTOP are hardware and software related capital expenditures necessary to maintain, operate, and upgrade these laboratories and their component systems

W83-70037 **505-35-13**
Langley Research Center, Hampton, Va
COMMUNITY RESPONSE TO NOISE
Robert C Goetz 804-827-3577
(532-06-13 505-33-53 505-32-33, 505-42-23)

The objective of this research is to develop technologies for quantifying and minimizing the impact of aircraft noise on airport community residents and on aircraft crews and passengers Research studies utilize laboratory tests to subjectively evaluate the properties of aircraft-generated noise that are responsible for causing annoyance The laboratory program is aimed at developing criteria for evaluating the noise from single aircraft events as well as valuating the response to longer term multiple aircraft exposures Subjects will experience the recorded noise of aircraft or the synthesized noise of future systems under simulated indoor, outdoor, and aircraft interior conditions Various psychophysical attributes such as annoyance and speech interference will be judged by the subjects The resulting single-event dose-response relationships will be directly applicable to the engineering assessment of source noise modifications and to aircraft certification procedures whereas the multi-event results will be applicable to the evaluation of aircraft/airport operations Field studies and/or the reanalysis of existing survey data will be directed toward the refinement of a predictive model of community acceptance which includes, in addition to the noise level, nonacoustical factors such as the number of events, the time of day/night, the population distribution, and any situational or psychological factors may influence response The model will be formulated such that it can be used to assess the noise abatement resulting from A/C modifications, A/C operational changes, and land-use strategies

W83-70038 **505-35-21**
Ames Research Center, Moffett Field, Calif
FLIGHT MANAGEMENT SYSTEMS
H P Klein 415-965-5094
(505-35-41, 505-35-51, 505-35-24)

This research is designed to identify factors which contribute to or cause human error in the aviation system, and to explore methods to prevent human error accidents by eliminating or by minimizing the adverse impact of such errors when they occur Descriptive studies of the Aviation Safety Reporting System data base are used to determine system factors associated with human error, and to identify potential solutions to the human error problems so identified Studies of pilot fatigue and circadian desynchronosis are being conducted to determine the extent to which these factors play a role in operational problems associated with aircrew performance The development and validation of standardized objective and subjective measures of pilot workload and performance will be conducted In addition the development of principles of automation/crew interaction will be pursued Specific analyses of future information transfer techniques will be examined to determine their effect on aircrew performance in both current and future flight management environments Virtually all activities in this RTOP are coordinated or joint with DOD

W83-70039 **505-35-23**
Langley Research Center, Hampton, Va
CREW COCKPIT INTERFACE TECHNOLOGY
J F Garren 804-827-3621

The objective of this program is the development of a technology base required for efficient operation in the current and future air transportation system, including technical integration of airborne systems with evolving air traffic control (ATC) systems technology, definition of display factors, control concepts, and intelligent aids for optimizing the utilization of crew capabilities, development of operating procedures to improve safety, efficiency, and capacity, and development of methodologies for assessing crew performance and workload Simulation facilities and flight vehicles, equipped with appropriate displays will be operated in conjunction with a simulated ATC environment to represent flight operations in an advanced en-route and terminal area environment

W83-70040 **505-35-31**
Ames Research Center, Moffett Field, Calif
PILOTED SIMULATION TECHNOLOGY
H P Klein 415-965-5094
(505-35-21, 505-42-41, 505-35-01)

The general objective of this research and development activity is

to provide a scientific and technical base that can be used as a resource to develop valid, reliable, and economical simulators for aeronautical research, development, and crew training Specific objectives are to (1) develop human factors principles that can be used to evaluate and guide the effective utilization of flight simulators in research and training, and (2) to develop advanced hardware and software concepts for high fidelity simulation of vision and motion environments The first of these two objectives will be met by continuing the study of human factors of optimal dynamic displays, including research on spatio-temporal parameters, resolution, dynamic range, field of view, environmentally reduced visibility, etc , refining an analytical method for evaluating simulator motion performance based on a human sensory processing model, and studying the use of mission oriented simulation for improving the quality of simulator training and research, especially for performance concerned with information transfer The second objective will be met by developing validation techniques for evaluation of CTOL, STOL, and rotorcaft simulations, developing techniques and concepts for simulation hardware, such as computer graphics displays, head up displays and motion systems, and developing computational techniques that increase the effective speed of digital simulation computers

W83-70041 **505-35-33**
Langley Research Center, Hampton, Va
FLIGHT SIMULATION TECHNOLOGY
J D Shaughnessy 804-827-3917

This RTOP's objective is the development and application of a technology base that will permit the economical and reliable substitution of simulators for actual flight operations in support of Langley's research programs It will cover both in-house and contractual studies which address how much fidelity is enough, can enough be quantified with precision, if we know quantitatively what we want in simulator design, can it be achieved and at what cost, and if achieved, what assertions can be made regarding validity? As a part of the agency-wide program, Langley participates in those areas that naturally evolve from the traditional base interests of the center Chief among those interests is the recognition that the development of engineering and perceptual requirements for man-in-the-loop simulation is a complex task involving trade-offs between simulation fidelity and costs In specifying the cue environment the designer must establish the need for particular cues as well as the requisite fidelity of presentation Unfortunately, the decisions are quite difficult to make objectively, inasmuch as the choices depend on complex psychological as well as engineering factors Particular emphasis will be placed at LaRC on several technical disciplines, moving within each discipline from a research cell focus for new and emerging technologies to fully integrated system studies and cost/benefit analyses These disciplines include vision/visual systems, man/vehicle performance assessment, atmospheric modeling, non-visual cue generation, computer science (real time), and analytical techniques and models for analysis of man/machine systems

Multidisciplinary Research

W83-70042 **505-36-11**
Ames Research Center, Moffett Field, Calif
FUNDS FOR INDEPENDENT RESEARCH (AERONAUTICS)
D J Peake 415-965-5113
(506-56-11)

The objective of this RTOP is to support innovative and discretionary basic research in areas related to aeronautics The program pursues basic investigations of new technologies in fundamental science and engineering needed to satisfy NASA's requirements in aeronautics including the technical fields of aerodynamics, fluid mechanics, flight mechanics, power, guidance and navigation, applied mathematics, propulsion and man-machine integration The OAST Research Council and the Ames Basic Research Council review unsolicited proposals that have been judged to be worthy of support on scientific or engineering grounds, but have not been selected for support because of funding limitations in other research programs Those research proposals that are judged by the Council and the ABRC to be worthy of support on a scientific or engineering basis are selected as candidates for funding

W83-70043 **505-36-12**
Lewis Research Center, Cleveland, Ohio
FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)
Marvin E Goldstein 216-433-4000

The objective is to support and encourage innovative, long range, high risk, basic research in areas related to aeronautics The program pursues basic investigations of, and facilitates exchange of information about new technologies in fundamental science and engineering needed to satisfy NASA's requirements in aeronautics Some of the specific technical fields are fluid mechanics (including turbulence and computational fluid mechanics) propulsion (including fluid mechanics, fans, compressors, fuels, combustors and mechanical components), aeroacoustics, materials, dynamics and control, and aeroelasticity The program is carried out primarily through grants which are selected by the Research Advisory Board It allows OAST to initiate fundamental studies in areas not presently included in a specific discipline program The funds are also used to bring speakers and visiting university scientists to the lab and to hold workshops and seminars

W83-70044 **505-36-13**
Langley Research Center, Hampton, Va
FUND FOR INDEPENDENT RESEARCH (AERONAUTICS)
R H Tolson 804-827-2664

The objective of this program is to support basic research in universities in areas related to aeronautics through the funding of a limited number of unsolicited research proposals University research proposals, that have been given high technical evaluations but are not funded through the research programs, are reviewed by the Langley University Research Proposal Review Committee Those research proposals that are judged by this committee to be worth supporting on a scientific or engineering basis are selected as candidates for funding through this plan The committee establishes a priority listing of these proposals and selects those efforts that are judged to be the more innovative and aimed at the longer term research of potential relevance to future NASA aeronautics programs

W83-70045 **505-36-21**
Ames Research Center, Moffett Field, Calif
AERONAUTICS GRADUATE RESEARCH PROGRAM
D H Hickey 415-965-5036

The objective of this program is to develop the interest of student engineers in the field of aeronautical engineering, provide on the job training in research methods, and augment or enhance NASA's research program The approach is to bring the center's needs to the attention of the academic community Research topics are established by mutual agreement and the tasks are especially selected to not only be relevant to NASA's mission and of interest to the university faculty, but to foster cooperative programs between the Government and Academia Cooperation may be evidenced by use of each others facilities and performance of the research at NASA installations The Ames/Moffett research conducted under this RTOP in FY-83 will include aerodynamics, acoustics flight mechanics, and computational fluid dynamics It will be both theoretical and experimental in nature The Ames/Dryden research supports work to improve methods and techniques in flight testing of aeronautical vehicles The program is to promote the overall improvement, in flight research through simultaneous advancement in instrumentation testing methods, equipment, data recording, and data analysis

W83-70046 **505-36-22**
Lewis Research Center, Cleveland, Ohio
GRADUATE PROGRAM IN AERONAUTICS
Marvin E Goldstein 216-433-4000

The objective is to sponsor graduate research and training in aeronautics which is relevant and acceptable to both NASA and the university Starting in FY-71, grants have been awarded, each for a performance period of approximately three years, in areas covering a broad spectrum of research activities relevant to the center's mission in aeronautics Specific fields of research include fluid mechanics, propulsion, aeroacoustics, materials, dynamics and control, aeroelasticity and noise emissions

W83-70047 **505-36-23**
Langley Research Center, Hampton, Va
GRADUATE PROGRAM IN AERONAUTICS
Robert H Tolson 804-827-2664

The objective of this plan is to support university research in aeronautics in which there is substantial involvement of graduate students at the Langley Research Center While formal classroom activities are conducted at a university campus, a substantial portion of the graduate research activity is carried out at the Langley Research Center in conjunction with Langley staff and overall guidance of a faculty advisor The research pursued under this RTOP is aeronautics related Research grants or cooperative agreements are awarded to a number of universities to pursue aeronautical research with support being mainly for graduate research students and to some extent faculty members associated with those students The selection of graduate research topics is determined by joint agreement between the university and NASA staff

W83-70048 **505-36-43**
Langley Research Center, Hampton, Va
JIAFS BASE SUPPORT
Robert Tolson 804-827-2664
(505-36-23)

The objective of this plan is to provide a core level of funding for the Joint Institute for Advancement of Flight Sciences (JIAFS), which is an extension of the School of Engineering and Applied Science, George Washington University, located at the Langley Research Center This core program allows the flexibility for developing new areas of research and through support for ongoing administrative personnel and provision for additional Graduate Research Scholar Assistantship appointments, will give JIAFS a degree of institutional stability and flexibility The specific research topics in the program will be determined through mutual agreement between LaRC and GWU

Computer Science and Applications Research and Technology

W83-70049 **505-37-01**
Ames Research Center, Moffett Field, Calif
NUMERICAL AERODYNAMIC COMPUTATIONAL TECHNIQUES
F R Bailey 415-965-6419

The primary objective of the numerical aerodynamic simulator (NAS) project is to design and develop a unique, large scale, high performance computational resource for solving viscous three dimensional fluid flow equations specially oriented toward the solution of aero and fluid dynamic problems A secondary objective is to generalize the computational resource for application to a broader scope of problems of interest to NASA The three major elements of the NAS project are the NAS processing system network (NPSN), the NAS facility housing the system and support personnel, and NAS operations providing the required operations, maintenance, and services support for system development and normal production operation The NPSN will be implemented in a four phased building block approach utilizing advanced state-of-the-art hardware and software either existing or currently in development The four phases are (1) network protocol development, (2) NPSN development system, (3) NPSN full system, and (4) NPSN upgrades This RTOP includes overall project planning, phase 1, phase 2 design, and ongoing operations support during development and normal operations It is anticipated that the implementation stages of phases 2 and 3 will be funded by a FY-84 new initiative outside of the scope of this RTOP

W83-70050 **505-37-13**
Langley Research Center, Hampton, Va
COMPUTER-AIDED DESIGN
R C Goetz 804-827-2042
(506-53-53)

The objective of the research is to exploit technical advances in computers to aid the engineering design and analysis process The scope of the effort includes development of techniques of data base management for large-scale engineering design activities as well as the use of special purpose computer hardware and software to facilitate structural computations In FY-83, the IPAD (Integrated Programs for Aerospace-Vehicle Design) project will continue research on large-scale design data base management Efforts will be focused on the implementation and evaluation of techniques to handle basic geometry in a multi-schema (multiview) environment On-going work will continue on the development of a Finite Element Machine (FEM), an array of microprocessors especially configured to solve structural analysis problems In FY-83, a 16-processor configuration will be assembled and its capability to perform relaxation and matrix inversion solutions on structural problems will be investigated

W83-70051 **505-37-20**
National Aeronautics and Space Administration, Washington, D C
AEROSPACE COMPUTER SCIENCE UNIVERSITY RESEARCH
Ronald L Larsen 202-755-2364
(506-54-50)

The objective is to (1) develop university-based center for aerospace computing technology focusing on concurrent processing, highly reliable computing, and scientific and engineering information management, and (2) foster cooperative, coordinated research coupling computer science with aeronautics, astronautics, and space sciences

W83-70052 **505-37-21**
Ames Research Center, Moffett Field, Calif
ADVANCED COMPUTATIONAL CONCEPTS
J O Arnold 415-965-6209
(506-54-51, 505-37-01, 505-31-01, 506-51-11, 506-53-11)

The objective is to systematically formulate and validate concepts of advanced computer architectures tailored to maximize computer power and cost effectiveness in the solution of large scale physical problems of growing interest to the agency Current focus is on computer systems optimized for computational fluid dynamics (CFD) and computational chemistry In CFD, computer systems for research on flows about aircraft will be developed In computational chemistry, computer systems applied to the determination of properties from first principles of small molecules and clusters of up to 50 atoms will be developed The approach is that selected computational physicists with extensive expertise in computer systems hardware and software will analyze requirements for their advanced problems which cannot be met by existing computational tools They, in collaboration with computer scientists, will develop several ideas for potential computer architectures meeting these requirements A concept will be validated by prototype modeling with inexpensive building blocks or by simulation on existing computers Once validated the concept would be reported in the appropriate literature, management briefings, workshops and seminars Immediate advances in the agency's capability to solve large scale computational physical problems would be realized with implementation of the full scale system

W83-70053 **505-37-31**
Ames Research Center, Moffett Field, Calif
CLASS VI COMPUTATIONAL CAPABILITY SUPPORT
D L Fisher 415-965-5015

The objective is to provide the research community at Ames with state-of-the-art computational tools which will enable the researchers, particularly in the computational physics community, to maintain their preeminence This will be accomplished through a contract which provides total computational capability including all components of the computer systems, as well as design, development, maintenance and operational functions

W83-70054 **505-37-32**
Lewis Research Center, Cleveland, Ohio
COMPUTATIONAL FACILITIES
Ralph K Everett 216-433-6163

This RTOP covers the cost for lease, purchase, and maintenance of the hardware and system software for the high speed analytical processor (Cray 1S computer system) The system will be installed in the central computer facility with the existing IBM 370/3033 attached processor providing the input and output for the system The system will be used primarily for scientific computation (math modeling) with the initial emphasis on analysis of aerodynamics, thermal, and structural performance characteristics of propulsion system components

Propulsion Systems Research and Technology

W83-70055 **505-40-02**
Lewis Research Center, Cleveland, Ohio
INLETS AND NOZZLES
R E Coltrin 216-433-6820
(505-43-82 505-31-02, 505-43-22 505-43-42)

A comprehensive flow prediction methodology for the design of inlets and nozzles will be generated to achieve higher performance with increased propulsion system stability Computer analysis programs for predicting internal and external flows will be synthesized in-house and by contracts and grants under RTOP 505-31-02 These programs will make it possible to analyze viscous and inviscid flows in two and three dimensions Basic benchmark testing will be one to define detailed flow phenomena to guide and verify the analysis Verification experiments will be conducted to verify accuracy of computer codes or design of actual components Inlet and nozzle hardware will be designed and used to conduct exploratory research in areas that are not presently amenable to analysis The effort in this RTOP was supported in FY-82 under RTOP 505-32-12 (Propulsion System Aerodynamics) In FY-83, RTOP 505-32-12 has been split into several RTOPs of which this RTOP is one

W83-70056 **505-40-12**
Lewis Research Center, Cleveland, Ohio
FAN AND COMPRESSOR RESEARCH
C L Ball 216-433-6835
(505-31-32)

The objective is to improve efficiency, operating range distortion tolerance, durability, and reliability, and to reduce the weight, volume, and cost of fans and compressors Increased emphasis is placed on fundamental high speed experiments to better understand the internal flow physics and to verify the internal flow analysis codes to improve the accuracy and reliability of the compressor design system The advanced internal flow analysis methods will result in improved designs and large cost savings by reducing the time required to incorporate advanced compressor technology into future engine development programs A new thrust directed towards developing a fundamental understanding of compressor stalling phenomena and how it is influenced by compressor design parameters is being pursued Models for predicting stalling characteristics and recovery of advanced compression systems will be developed Small compressor research is also being emphasized to provide advanced technology that is applicable to small as well as large propulsion systems

W83-70057 **505-40-22**
Lewis Research Center, Cleveland, Ohio
COMBUSTORS AND TURBINES
R A Rudey 216-433-6625
(505-31-42, 533-04-12)

The objective of this program is the improvement of performance, life, and reliability of combustors and turbines for civil and military applications Combustor research will include anaytical model development and verification as well as the identification and evaluation of advanced combustor and fuel system concepts The effects of fuel property variations on the performance, reliability, and durability of fuel system components will be investigated and advanced fuel system concepts will be identified and evaluated that enable the use of broader property fuels Turbine research will involve improved cooling and aerodynamic design methods for axial and radial turbines This work, in conjunction with related programs in fundamental analysis and experiments and hot section technology, will result in large cost savings by reducing the time required and the risk involved in incorporating advanced components into future engine development programs

W83-70058 **505-40-32**
Lewis Research Center, Cleveland, Ohio
PROPELLER RESEARCH
D C Mikkelson 216-433-6820
(535-03-12, 505-31-02, 505-32-02, 505-41-43)

The objective of the Propeller Research Program is to advance the technologies which are critical to efficient, acceptable propeller propulsion both at high subsonic speeds (Mach 0 7 to 0 8) and at lower speeds typical of business aviation and small short haul aircraft This objective will be accomplished by conducting analytical and experimental investigations of advanced propellers incorporating integrated aerodynamic, acoustic, and aeroelastic design for flutter-free operation at both high subsonic flight conditions (up to Mach 0 8 and 35,000 feet altitude) and low speeds (Mach 0 6 and below) Acoustic characteristics will be evaluated for both advanced high tip-speed propellers and advanced low speed propellers Analytical and experimental investigations will be conducted to maximize the performance and minimize flow interactions involving propeller, slipstream, core inlet, and nacelle

W83-70059 **505-40-42**
Lewis Research Center, Cleveland, Ohio
POWER TRANSFER RESEARCH
E V Zaretsky 216-433-6101

The objectives of this work are to advance the state-of-the-art in the technology of transmissions and of mechanical components such as bearings and gears Goals are to achieve improved component performance, life, noise, weight, reliability, and efficiency in the high temperature and high speed environments of turbojet and turbofan engines and mechanical power transmission systems for helicopters, V/STOL, and turboprop application Emphasis will be given to analytical performance predictions with experimental verification to create far term opportunities as well as to satisfy goals for both improved component and system performance Experimental studies will be performed with standard type transmissions with improved bearing and gear components and with advanced hybrid and traction transmissions using traction contacts Materials, lubricants, and design variables will be studied for improved component and system reliability and life

W83-70060 **505-40-52**
Lewis Research Center, Cleveland, Ohio
CONTROLS AND INSTRUMENTATION
N Wenger 216-433-4000
(505-31-52, 505-34-02, 506-54-12)

The objective of this RTOP is to both develop and apply advanced in instrumentation and measurement systems for use in component research, engine systems research, and eventually in operational systems The research is focused on developing a technology base for producing high temperature transducers and electronic systems that can operate uncooled on or in close proximity to a turbine engine for the purposes of control, condition monitoring, or experimentation The applications part of the RTOP is focused on further development and demonstration of state-of-the-art prototype instrumentation in LeRC experimental facilities Major emphasis in the applications area is the use of microcomputers and minicomputers for the automation of instrument with respect to operation, calibration, and pre-run checkout Another objective is to improve the understanding of propulsion system dynamics and to provide an improved technology base for future engine control system development Experimental and analytical efforts are undertaken to support the various technical disciplines associated with the dynamics and control of propulsion systems Real-time dynamic simulations of propulsion systems are developed using hybrid computers Research into the use of parallel microprocessors for real-time simulation is also conducted Innovative propulsion control components are developed, with emphasis on electro-optical sensors and actuators Analytical and experimental research is conducted on post-stall engine system dynamic behavior Control modes for avoidance of and recovery from rotating stall are synthesized and evaluated using simulations and engines

W83-70061 **505-40-62**
Lewis Research Center, Cleveland, Ohio
ENGINE SYSTEMS RESEARCH
W T Wintucky 216-433-6946

One objective of this RTOP is to improve the understanding and technology base of propulsion system behavior and establish analytical engine dynamic prediction techniques Dynamic research and studies will be conducted on advanced civil and military engines on component interactions, flow distortions, system stability, and stall recovery on system behavior and performance Studies will be made of component and system performance for improving fuel economy and defining engine system behavior in the over 50 Hz frequency In addition, the research will define and establish the technology base for the most promising advanced small engines for future small engine, commuter, rotorcraft, and light military aircraft for the late 1980's and on The advanced engines having multifuel capability, substantially lower BSFC, weight, maintenance and improved reliability are being defined through studies and engine tests, supplemented by analyses and experimental investigations in key technology areas A final objective will be to perform studies of the feasibility and potential benefits of advanced propulsion concepts, to identify technology research requirements, and define opportunities for capitalizing on technology advances Studies will be performed of engine cycles, propulsion systems, and engine/airframe combinations in aircraft missions

W83-70062 **505-40-70**
Lewis Research Center, Cleveland, Ohio
ENGINE SYSTEMS FACILITIES OPERATIONS
J A Yuska 216-433-6898

This RTOP covers the operation, maintenance, repair, and improvements of the Propulsion System Laboratory (PSL) and the engine static test stands (ECRL-2 and Vertical Lift Fan Facility (VLFF)) at LeRC The PSL complex consists of two altitude test chambers, designated as PSL-3 and PSL-4 The ECRL-2 is an indoor static stand and VLFF is an outdoor static stand The objective is to provide safe and productive operations of the engine test facilities for propulsion and aerodynamic systems research and technology directed towards improving systems technology for future turbofan, turbojet, and turboshaft engines This will be accomplished through the application of research sub-programs to advanced civil and military engines This RTOP covers the cost of operating PSL, ECRL-2, and VLFF in support of the above research plus the cost of maintaining, repairing, and assuring the safety of these major facilities Funding for improving the facilities capabilities, maximizing the productivity, and improving energy efficiency are also included

W83-70063 **505-40-72**
Lewis Research Center, Cleveland, Ohio
WIND TUNNEL OPERATIONS
A J Gnecco 216-433-5579

This RTOP covers the cost of maintenance, normal repair, and limited improvements of all the wind tunnel facilities at LeRC These

facilities consist of the 10x10 foot supersonic wind tunnel, 8x6 foot supersonic wind tunnel, 9x15 foot low speed wind tunnel, and the 6x9 foot icing research tunnel (IRT) The costs of operating the wind tunnels during research testing and to prepare the tunnel for specific research tests are not covered under this RTOP

Rotorcraft Research and Technology

W83-70064 **505-42-11**
Ames Research Center, Moffett Field, Calif
ROTORCRAFT AEROMECHANICS AND CONFIGURATIONS
D H Hickey 415-965-5036
(505-42-11, 532-03-11, 532-06-11)

This RTOP covers research on rotor aerodynamics, dynamic loads and stability, performance and noise characteristics, rotorcraft flight dynamics and rotorcraft human factors Theoretical and experimental research will be conducted to improve fundamental understanding and develop techniques to design rotors optimized for aerodynamic performance and noise reduction These techniques will include the effects of planform geometry, airfoil section, dynamic stall and wake induced inflow Analytical models for the flow about rotorcraft fuselages, including wake interaction, will be developed The understanding and predictive capability of the aerodynamic and dynamic phenomena of advanced rotorcraft will be improved by conducting analytical, small scale, and full scale experimental investigations of helicopter performance and noise, rotor aerodynamics and wake characteristics, drag and aerodynamic interference and rotor loads, vibration and vibration reduction systems Specific advanced rotor configurations will be tested in the full scale wind tunnel Flight dynamics research will be conducted to provide handling qualities and design criteria for specific missions The research will be conducted through analysis, including math model improvement and development of advanced techniques of control system implementation, ground based piloted simulation, and flight research with the UH-1H (with V/STOLAND), and CH-47 Human factors research will concentrate on fundamental laboratory studies to reveal the needs and information processing of helicopter pilots In particular, studies will continue on auditory signals to provide important pilot cues, the use of peripheral vision, and an evaluation of workload measurement techniques

W83-70065 **505-42-23**
Langley Research Center, Hampton, Va
ROTORCRAFT AIRFRAME SYSTEMS
Robert C Goetz 804-827-2042
(532-06-42)

The technology for the application of composite materials and design concepts in helicopter structures to improve performance and efficiency, reduce costs, and provide durability and energy absorption capability equivalent of metal structures will be developed through in-house and contractual studies Long-term durability of Kevlar secondary structures and graphite primary structures will be determined through flight service and structural testing studies Impact dynamics characteristics of composite structures will be evaluated Through analysis, wind tunnel, and flight studies, effective means for reducing helicopter vibrations, improving performance, and evaluating aeroelastic characteristics of new rotor systems will be determined Active higher harmonic control of vibrations will be demonstrated in flight Improved predictive methods for analysis of the unsteady airloads on rotors will be developed through in-house and contract studies Analytical and experimental studies will be made to identify significant factors contributing to the aerodynamic, acoustic, and aeroelastic characteristics of rotors

W83-70066 **505-42-32**
Lewis Research Center, Cleveland, Ohio
ROTORCRAFT-OPERATING PROBLEMS
N E Samanich 216-433-6604
(505-42-21, 505-42-31, 530-02-11, 505-44-12 511-58-12)

Part of the NASA rotorcraft program is aimed at advancing technology in engine components, transmissions and propulsion system integration Objectives are to improve propulsion system durability, reliability and cruise fuel consumption, to reduce life cycle costs, to develop propulsion technology unique to high productivity vehicles, and to increase operational capability and flexibility Because of recent funding cutbacks, it has become necessary to transfer all generic small engine component efforts to the R&T division of OAST Future work is being directed toward solving the unique operating problems of military and civil rotorcraft with particular emphasis on propulsion technology and icing Recent and planned activity encompasses studies optimizing propulsion systems for high speed rotorcraft, evaluation of various contingency power concepts with some verification testing, full authority digital electronic controls research and studies of methods to improve part power efficiency Power transfer technology is directed toward improving large gear analyses techniques along with examining new concepts which could improve efficiency, reliability, and reduce weight and noise Although there is some work continuing involving inlets, rotorcraft icing research is aimed primarily at establishing and verifying analytical methodology for use in rotor ice prediction and ice protection systems

W83-70067 **505-42-81**
Ames Research Center, Moffett Field, Calif
LOW SPEED WIND TUNNEL OPERATIONS
J V Kirk 415-965-5045

This RTOP covers support and operation of the National Full Scale Facilities Complex (40- by 80-foot wind tunnel, 80- by 120-foot wind tunnel, and the Outdoor Aerodynamic Research Facility) and the 7- by 10-foot wind tunnel number one The objective of this RTOP is to support research on basic fluid mechanics, rotorcraft aeromechanics and acoustics, V/STOL aerodynamics, and the high-lift aerodynamics of conventional aircraft The 40- by 80-foot wind tunnel is operational and the 80- by 120-foot wind tunnel will become operational in the second quarter of FY-83 Early research programs in the 40- by 80- include the bearingless main rotor, rotorcraft interactional aerodynamics, and high angle-of-attack research First research programs in the new 80- by 120- include the tilt nacelle turbofan V/STOL model and the DeHavilland augmentor V/STOL model The 40- by 80-/80- by 120-foot wind tunnel is scheduled for a combined 1 5 shift per day occupancy The outdoor aerodynamic research facility (OARF) and the 7- by 10-foot wind tunnel are scheduled for a combined one shift per day occupancy Variable frequency power (150 HZ) is being installed at the OARF to allow rotor research at this facility Delivery of a rotor test rig for the 7- by 10- will allow increase rotor testing in that facility A new control room and wind tunnel balance improvements will increase the efficiency of the tunnel Research investigations at the OARF in FY-83 include rotor noise, rotorcraft interactive noise, the tilt nacelle V/STOL, and VEO/V/STOL nozzle, while the 7- by 10- programs include forward swept wing, rotor noise, and high lift investigations

High-Speed Aircraft Research and Technology

W83-70068 **505-43-01**
Ames Research Center, Moffett Field, Calif
GEODYNAMICS/FLIGHT DYNAMICS OF POWERED LIFT VEHICLES
Bedford A Lampkin 415-965-6039

The objective of this RTOP is to develop basic research and technology required to enable the development of military and civil aircraft having V/STOL and STOL capability and viable mission performance Theoretical and experimental generic research will be undertaken in the areas of high-speed aerodynamics, low-speed aerodynamics, and flight dynamics To ensure that all major high-speed propulsion system/airframe interactions are accounted for properly, compact propulsion simulator technology will be developed for use in scale wind tunnel models of powered lift configurations Methods or predicting high-speed aerodynamic performance will be refined Low-speed wind tunnel aerodynamic research will continue to develop aerodynamic prediction techniques for both transition and ground effects The experimental data base will be expanded using large-scale components and complete models Research will also include improvement of experimental techniques and evaluation of ejector thrust augmentation Flight control system and display requirements will be investigated concurrently, primarily through piloted simulation and through flight research in collaboration with the Royal Aircraft Establishment of the U K in conjunction with the NASA/MOD (PE)

W83-70069 **505-43-02**
Lewis Research Center, Cleveland, Ohio
POWERED LIFT PROPULSION TECHNOLOGY
L W Gertsma 216-433-5165

An efficient, lightweight, reliable propulsion system is a critical requirements for the successful design of powered lift aircraft The technology base for the propulsion system will be developed in selected critical areas which are unique to the powered lift concept Analytical and experimental investigations will be conducted in the areas of inlets, thrust deflector nozzles, and thrust control devices operating in the hover and transition modes for both subsonic and supersonic propulsion system concepts

W83-70070 **505-43-11**
Ames Research Center, Moffett Field, Calif
HIGH PERFORMANCE AIRCRAFT FLIGHT DYNAMICS AND FLYING QUALITIES
G N Malcolm 415-965-6266
(505-31-21)

The objective of this effort is to provide a basic understanding of the aerodynamic, flight dynamic, and flying qualities of highly maneuverable, high performance aircraft through the development and utilization of improved wind tunnel and flight test measurement and analytic techniques Ultimately, through application of improved methods of testing and application of results (including better simulations resulting from improved aerodynamic mathematical models and flight validated data bases), criteria can be established for designing vehicles with improved flying qualities over an expanded angle of attack and Mach number envelope Various wind tunnel experimental capabilities for determining aircraft and dynamic characteristics are being investigated, including all phases of high-maneuver flight from controlled motions to fully developed spins Emphasis on test capabilities at high Reynolds numbers is particularly important in order to achieve realistic correlation with flight test results Studies are underway to improve analytical techniques for determining stability and control derivatives from flight data and to develop new techniques for evaluating handling qualities Improved techniques will be studied to estimate the unknown aerodynamic parameters of the aero/math model and to improve the identifiability of the system parameters from flight data A coordinated program of wind tunnel and flight tests is planned to provide validation of aerodynamic math models

W83-70071 **505-43-13**
Langley Research Center, Hampton, Va
HIGH PERFORMANCE AIRCRAFT FLIGHT DYNAMICS & CONTROLS
R E Bower 804-827-3285

The broad objectives are to improve the stall/spin characteristics of high performance aircraft, and to determine and evaluate architecture of integrated digital airframe/propulsion control systems for such vehicles Specific objectives of the stall/spin research are (1) to investigate the fundamental nature of stall/spin including the development of test techniques and theoretical methods, (2) to develop and evaluate automatic spin prevention concepts (3) to determine static and dynamic aerodynamic characteristics at high angle of attack, and (4) to determine geometric characteristics which result in inherent spin resistance Methods of approach for these efforts include static and dynamic wind tunnel force tests, theoretical analysis, piloted simulator tests, and dynamic model flight tests Extensive participation in DOD airplane programs is involved Specific objectives of the integrated controls research are (1) to assess the benefits/disadvantages of system architectures with airframe/propulsion control coupling, (2) to identify key hardware elements requiring development to insure availability for advanced applications, (3) to design, build, and evaluate the selected systems, and (4) to assess the need for flight tests demonstration The system evaluaion research will be conducted in the Langley Avionics Research Laboratory The controls program is directed by the Langley Center with technical assistance by the Lewis Research Center

W83-70072 **505-43-22**
Lewis Research Center, Cleveland, Ohio
NON-AXISYMMETRIC NOZZLE RESEARCH
R G Willoh 216-433-6624

The objective is to establish, through analytical studies and system design efforts, as well as model and full-scale experimental research programs, the technology base required for the application of original configurations to future combat aircraft The Lewis effort is focused on internal flow of non-axisymmetric exhaust systems Current activities are specifically directed toward providing the technology required for the design of non-axisymmetric exhaust nozzles for turbine engines The high maneuverability and STOL requirements anticipated in future aircraft designs lead to the application of non-axisymmetric nozzles capable of thrust vectoring and reversing Principal areas of concern will include cooling, heat transfer, structural design, weight, and internal aerodynamics The objectives will be accomplished through contract and in-house studies, nozzle design, and experimental research Particular emphasis will be placed on solutions to the complex cooling, structural and internal aerodynamic problems associated with non-axisymmetric nozzles Close coordination will be maintained with Langley Research Center, the Navy and the Air Force to assure that work in the propulsion area appropriately supports DOE Requirements and the aerodynamic work at Langley

W83-70073 **505-43-23**
Langley Research Center, Hampton, Va
HIGH-SPEED AERODYNAMICS AND PROPULSION INTEGRATION
Roy V Harris, Jr 804-827-2658

The technical objective of this work is to develop the aerodynamic technology base for the design of future military aircraft and missile concepts Analytical and experimental studies will be made to develop aircraft design rationale and evaluate advanced aerodynamic concepts such as supercritical aerdynamics, wing warp, maneuver devices, thrust-induced lift, nonaxisymmetric nozzles, and component interference Similar studies will be made to extend the aerodynamic technology base for missile systems including conventional cruciform stability and control concepts, airbreathing propulsion integration, and monoplanar concepts Studies will also be made to provide a technology base for evaluation of missile carriage and separation aerodynamics

W83-70074 **505-43-31**
Ames Research Center, Moffett Field, Calif
INTERAGENCY ASSISTANCE AND TESTING - DRYDEN
R G Bryant 805-258-3311

This RTOP is intended to cover interagency and intercenter assistance using applicable Dryden flight test facilities The broad objective is to provide technical assistance, consultative services and test facility support to DoD for military programs and to industry and other NASA Centers, which involve specific requests for NASA support Past activities of this kind include a B-52 drop test for recertification of the F-111 crew escape system, component improvement tests involving F-15, T-37, F-111 aircraft and support of the AFTI/F-16 program Some current activities include conduct of Air Force F-111 crew module recovery system tests and planning for Marshall Space Flight Center solid rocket booster recovery system tests Analysis of test results will be performed and selected results will be documented Consultation will include participation in pre-test conferences, technical evaluation boards, and technical coordination committees

W83-70075 **505-43-32**
Lewis Research Center, Cleveland, Ohio
INTERAGENCY & INDUSTRIAL ASSISTANCE & TESTING
A J Gnecco 216-433-5579

The objective of this RTOP is to support requests from DOD, FAA, other Federal agencies outside NASA and the aircraft/missile industry for aerodynamic testing in facilities at the Lewis Research Center The facilities typically used under this RTOP include 10 x 10 SWT, 8 x 6 SWT, 9 x 15 WT, icing tunnel, and PSL Additional support is also provided in the form of technical assistance, consultative services and participation in the technical evaluation of developing aircraft and missile concepts

W83-70076 **505-43-33**
Langley Research Center, Hampton, Va
INTERAGENCY AND INDUSTRIAL ASSISTANCE AND TESTING
Roy V Harris, Jr 804-827-2658

The broad objective is to provide technical assistance and consultative services to outside agencies and aircraft industry programs which involve specific requests for NASA support The principal assistance is to the Department of Defense for aircraft and missile development programs Currently, activity is focused in the areas of stall/spin, aerodynamic characteristics at subsonic, transonic, and supersonic speeds, flutter and aeroelasticity, structures, landing loads, simulation and propulsion system interactions on airframes and nozzles The approach will involve tests in applicable Langley facilities consistent with the availability of test time and the utilization need for the particular facilities requested Analysis of test results will be performed and selected results will be documented Consultation will include participation in pretest conferences, technical evaluation boards, and technical coordination and oversight committees

W83-70077 **505-43-42**
Lewis Research Center, Cleveland, Ohio
SUPERSONIC PROPULSION INTEGRATION TECHNOLOGY
R E Coltrin 216-433-6820
(505-40-02, 505-43-82, 505-31-02, 505-43-22)

A technology data base for high-speed military and civil aircraft design concepts incorporating improved propulsion system/airframe integration techniques will be generated Present high speed inlet/engine/nozzle/airframe integration concepts and methods will be evaluated and the generation of advanced concepts and methods will be initiated Inlet aerodynamic, stability, and control analysis/design methods will be assembled and evaluated Existing inlet or nozzle hardware will be modified or new hardware will be built and tested to verify aerodynamic and control analysis methods and to provide a data base for areas

such as low speed aeroacoustics and the variale diameter centerbody inlet concept These studies and tests will be conducted both in-house and on contract or grant

W83-70078 **505-43-43**
Langley Research Center, Hampton, Va
SUPERSONIC AERODYNAMICS, CONFIGURATIONS, INTEGRATION, STRUCTURES & MATERIALS TECHNOLOGY
D J Maglieri 804-827-3838

The objective of this RTOP is to develop a technology data base for high-speed military and civil aircraft design concepts of advanced configurations incorporating improved aerodynamic performance, propulsion system/airframe integration techniques, and structures and materials This will be accomplished primarily through in-house studies and experimentation to (1) establish a supersonic aerodynamic technology base permits improvements in L/D, reduction in drag, refinement of aircraft concepts, and optimization of aircraft characteristics over the full operating speed range, (2) evolve and refine advanced military and civil aircraft configurations that provide advancements in performance, range, speed, volume, boom signature, fuel consumption, etc, and (3) establish a high temperature structures and materials technology base that permits significant reductions in structural weight by research on new materials, structural design, and fabrication techniques providing satisfactory fatigue, fracture, and thermal/cyclic life characteristics under high speed flight conditions

W83-70079 **505-43-61**
Ames Research Center, Moffett Field, Calif
HIGH-SPEED WIND TUNNEL OPERATIONS
Daniel P Bencze 415-965-5848

This RTOP covers the operation, maintenance, repair, and enhancement of the high speed wind tunnels at ARC These facilities consist of the unitary plan wind tunnels (11-foot transonic, 9-by 7-foot, and 8-by 7-foot supersonic), 12-foot pressure wind tunnel, 2-by 2-foot and 14-foot transonic wind tunnels, and the 6- by 6-foot supersonic wind tunnel In addition, a number of smaller scale aerodynamics research and test facilities are maintained and supported as required The objective of the RTOP is to provide aerodynamic testing in support of research and technology programs for NASA, DOD, industry, and other government agencies Wind tunnel tests will be conducted to generate experimental test data to advance the state of the art in generic research and vehicle configuration research In addition, facility enhancements and modifications are developed and implemented to meet the testing requirements of the industry and to maximize the energy efficiency and productivity of the facilities The facilities themselves are maintained on a scheduled basis and repaired as required to maintain the desired level of testing and ensure continued safe operations

W83-70080 **505-43-81**
Ames Research Center, Moffett Field, Calif
HYPERSONIC AERONAUTICS TECHNOLOGY
Berwin M Kock 805-258-3311

The hypersonic vehicle program is conducting research addressing the technology needs of long range cruise airplanes designed to operate at Mach numbers in excess of 3 0 The YF-12 research program provided an engineering data base that is supportive of the hypersonic program The focus of this RTOP is to apply that data base, as well as the experienced engineering personnel, to the aerodynamics, propulsion, structures and airplane operational disciplines for hypersonic vehicles Analysis and laboratory testing will be provided Dryden activities are in support of program lead by the Langley and Lewis Research Centers

W83-70081 **505-43-82**
Lewis Research Center, Cleveland, Ohio
HYPERSONIC PROPULSION INTEGRATION TECHNOLOGY
R E Coltrin 216-433-6820
(505-43-42, 505-31-02, 505-40-02)

A program of applied research will be conducted to develop key propulsion and propulsion airframe integration technologies for application to air-breathing aircraft in the Mach 3-5 flight regime A data base of performance and operational characteristics for advanced supersonic/hypersonic propulsion (inlet/engine (s)/airframe) concepts will be generated Current inlet analytical prediction methods will be evaluated using this data base Key propulsion barrier technologies will be identified for further investigations These studies will be conducted inhouse and on contract and is a joint LaRC/LeRC program

W83-70082 **505-43-83**
Langley Research Center, Hampton, Va
HIGH SPEED (SUPER/HYPERSONIC) TECHNOLOGY
R V Harris, Jr 804-827-2658

The program is aimed at fundamental aerodynamic, propulsion, and structures technologies to support future development of airbreathing aircraft and missiles in the Mach 3 to 7 class The NASA in-house research capabilities and facilities will be utilized, supplemented by selected contracts and grants, to develop and combine critical methodologies The aerodynamics effort will concentrate on propulsion/airframe integration aspects of hypersonic configurations, including the forward aircraft flow field, spillage effects, and exhaust nozzles for multicycle turboramjet engines Scramjet propulsion research will consist of combustion fundamentals for hydrogen and hydrocarbon fuels to include analytical techniques and flow field diagnostics, and of component and engine testing of investigate feasibility for the Langley airframe-integrated modular scramjet concepts The structures focus will be on the testing of titanium sandwich panels for the wing skin of Mach 5 aircraft (at Dryden), on scramjet fuel injector strut design and fabrication, and on concepts applicable for methane fueled engines The approach will combine the development and application of advanced analytical methods with representative experiments A parametric range of geometric shapes will be addressed to identify the best fundamental approaches to high vehicle, engine, and structures performance Detailed flow field analyses will include parabolic and elliptic three-dimensional techniques, embedded shocks, inlet spillage effects, shock boundary layer interactions, fuel injection, mixing, and combustion

Subsonic Aircraft Research and Technology

W83-70083 **505-45-01**
Ames Research Center, Moffett Field, Calif
B-57B FLIGHT INVESTIGATION OF ENVIRONMENTAL HAZARDS
W D Painter 805-258-3311

The objective of this work is to support the improvement of the definition of atmospheric characteristics required for advanced aircraft design and for more efficient, safe aircraft operation Phenomena which are emphasized include clear air turbulence, wind shear, temperature transients, pressure altimetry problems and aircraft icing Data on these phenomena are obtained from an instrumented B-57B aircraft and are related to the meteorological conditions causing them by the use of mathematical models and climatological information This work will be covered by study efforts, both in-house and on contracts or grants from NASA Marshall Space Flight Center (MSFC) as well as the development and acquisition of sensors needed to measure the atmospheric phenomena Results of this work are applicable to aircraft system design, flight test activities, and flight operations

W83-70084 **505-45-02**
Lewis Research Center, Cleveland, Ohio
AIRCRAFT ICING RESEARCH
J J Reinmann 216-433-5542

The objective of this program is to update and advance the technology related to the safe operation of aircraft in atmospheric icing conditions The program addresses the ice protection needs of general aviation light transports, commercial transports, and helicopters The program is broadbased, encompassing both analytical and experimental research, and is conducted using in-house, contracted, and university effort Icing R&D testing will be conducted in the NASA-Lewis Icing Research Tunnel, and in flight tests in natural icing clouds and behind icing cloud simulators The research will be coordinated among the aircraft industry/users, civilian government agencies, and the military NASA will serve as the focal point for assembling and disseminating a wide range of data

W83-70085 **505-45-03**
Langley Research Center, Hampton, Va
AVIATION SAFETY: SEVERE STORM HAZARDS
J W Stickle 804-827-2037

The aim is to improve the knowledge and understanding of atmospheric processes as they affect the design and safe and efficient operation of aircraft and aircraft systems Experimental and analytical programs will be structured to provide data on and new methods for improving the predictability, detection, and avoidance of severe storm hazards, and basic data for the design for those hazards which cannot be avoided Specific hazards are precipitation (amount and kind), wind and wind shear, turbulence, and in-flight lightning

W83-70086 **505-45-05**
Jet Propulsion Laboratory, Pasadena, Calif
CLEAR AIR TURBULENCE STUDIES USING PASSIVE MICROWAVE RADIOMETERS
B L Gary 213-354-3198

This RTOP is for continuation of a flight evaluation of the 'clear air

turbulence' airborne microwave radiometer (AMR) The AMR is installed in the NASA/Ames C-141 'Kuiper Airborne Observatory' The instrument uses passive remote sensing techniques to determine altitude temperature profiles, which cover a 6000 ft altitude region centered on the aircraft's altitude These profiles can be used to locate tropopause and inversion layer features Clear air turbulence, CAT, is generated at the tropopause and within inversion layers Although it is 'felt' at other altitudes, CAT severity is strongest at the altitudes where is is generated Thus, knowledge of the altitude of the tropopause (or an inversion layer) is equivalent to knowledge about where CAT is most likely to be generated (and to be most severe) If CAT is being felt, or if it is expected (based on 'pilot reports', or another sensor's 'when' prediction), the AMR provides a basis for requesting altitude changes that may reduce the severity of the CAT encounter The principal objective of the RTOP is to obtain flight statistics on the occurrence of CAT at the tropopause, within inversion layers, and at other altitudes These statistics will enable an evaluation to be made of the merits of using the AMR as a CAT avoidance sensor

W83-70087 **505-45-09**
Marshall Space Flight Center, Huntsville, Ala
SAFETY - ATMOSPHERIC PROCESSES
Dennis W Camp 205-453-2087

The objectives are to (1) define, investigate, and model atmospheric conditions having adverse effects on aircraft operations relative to efficiency and safety, (2) conduct research relative to the development of techniques and procedures for enhancing safe and efficient operations of aeronautical systems, and (3) development and/or improve meteorological instrumentation and methods as needed to accomplish the first two objectives The variation in atmospheric backscatter at CO2 lower wavelengths (9 to 11 microns) and effect on the performance requirements for operational aircraft systems will be studied Enhancement of lidar velocity signals will be investigated The approach will be to continue to (1) measure and analyze atmospheric data, (2) develop models of atmospheric boundary layer properties and conditions which lead to or intensify them, (3) perform analytical and field tests relative to investigating warm fog dispersal, and (4) develop and/or modify instrumentation as needed to meet requirements of this approach To accomplish the objectives, the following tasks will be performed correlation of lateral and longitudinal gusts, atmospheric dynamics processes definition, warm fog dispersal, characterization of atmospheric electrical phenomena, applied laser technology, analysis of Doppler lidar measured winds, conduction of aviation meteorology workshop and interagency meteorology retreat, investigation relative to needed new and/or improved instrumentation and methods for safety and efficiency of aeronautical systems, and interagency wind shear research (JAWS)

W83-70088 **505-45-11**
Ames Research Center, Moffett Field, Calif
OPERATIONAL PROBLEMS FIREWORTHINESS AND CRASHWORTHINESS
C T Snyder 415-965-5009
(505-33-31)

One objective of this RTOP is to improve aviation safety by increasing understanding of the causes of accidents, and by developing systems technology and piloting techniques for avoiding hazards Research on post-accident analysis techniques is a cooperative program with the National Transportation Safety Board (NTSB) Research will also be conducted in a technology to reduce the hazards associated with wind shear and to enhance the operational safety of IFR operations for civil and military rotorcraft and V/STOL aircraft A second objective of this RTOP is to improve aircraft crashworthiness and cabin safety in post-crash fires The program includes (1) development of a cost beneficial survivability model for aicraft fire safety, (2) fuel anti-misting studies and the determination of fluid properties of modified jet fuel for inhibiting the ignition of fuel, (3) development of fire retardant and crashworthy composites for interior applications such as aircraft seats, (4) development of lightweight graphite composites for fire-resistant aircraft interiors, (5) development of fire test methodology such as measurement of the mass injection rate of materials into the environment, (6) fabrication of advanced aircraft interior materials for testing by the FAA, and (7) full-scale demonstration of the technologies for improved survivability

W83-70089 **505-45-15**
Jet Propulsion Laboratory, Pasadena, Calif
AVIATION SAFETY TECHNOLOGY - APPLIED FLUID MECHANICS/FIRE MATERIALS MODELING
Lloyd Back 213-354-3537

The overall objective of this effort is directed toward improving aircraft fire safety The studies include those aspects of safety associated with (1) experimental investigations to study the ignition and flame spread characteristics of aircraft ceiling panels, and the interaction between a pool fire and ventilation crossflow in a one-third scale aircraft cabin simulation, and the evaluation and development of a detailed enclosure fire dynamics model, utilizing the JPL pool fire and flame spread test facility, (2) the development of a detailed fire modeling methodology for the prediction of aircraft fire characteristics, and (3) thermochemical modeling of burning materials

W83-70090 **505-45-17**
Lyndon B Johnson Space Center, Houston, Tex
AIRCRAFT FIRE SAFETY MATERIALS TESTING
D E Supkis 713-483-3211

This RTOP consists of work originally started in FY-75 and continued through FY-81 The RTOP provides for developing and testing new, lightweight, fire-retardant, nonmetalic materials, continuing development and characterization of polyimide end items, developing secondary aircraft structures, the fabrication of modules for in-house testing, testing by the aircraft industry and by FAATC, toxicity support for evaluation of candidate state-of-the-art materials, and for providing manpower support for these various tasks including delivery of technical data and reports

W83-70091 **505-45-22**
Lewis Research Center, Cleveland, Ohio
AIRCRAFT FUEL EFFICIENCY IMPROVEMENT
D L Nored 216-433-6948

Results from Phase I indicate that if the detail implicit in high-resolution windfield and temperature data can be retained, fuel savings of between 2 and 4 percent are possible The objective of Phase II will be to evaluate those technologies which offer the most promise in translating this potential fuel savings to operational status to meet the needs of the United States aviation industry To achieve this objective, the use of man-computer interactive video techniques will be applied to the development of a high-resolution wind-and temperature-data base at cruise altitudes This data base, consisting of satellite, aircraft, radiosonde, and numerical-weather-prediction model data, when optimized through human/computer interactive methods, will be evaluated against the present operational data base as well as against actual data

W83-70092 **505-45-23**
Langley Research Center, Hampton, Va
AIRCRAFT LANDING DYNAMICS
R C Goetz 804-827-2042

The objective of the research is to measure the landing environment and the dynamic response of advanced landing systems to provide technology for safe economical all-weather aircraft ground operations The scope of the effort includes investigation of the dynamics of tires and air cushions, braking and steering response of advanced systems, as well as definition of landing hazards such as low altitude turbulence, runway slipperiness, and tire blowouts In FY-83, efforts to develop and confirm analytical tire models will continue Based on new test data, efforts will be made to develop software simulations of antiskid braking dynamics to support landing gear design and for application to aircraft ground-handling simulators In air cushion landing system research, air cushion stability analysis will be refined and methods of braking and steering will be investigated Work will continue to upgrade the Aircraft Landing Dynamics Facility to accommodate significantly higher landing speeds In landing hazard work, in-flight, low altitude turbulence measurements will be made during approach and landing conditions to improve understanding and modeling of turbulence hazards Also, runway friction measurement research related to aircraft stopping performance will continue

W83-70093 **505-45-43**
Langley Research Center, Hampton, Va
AERODYNAMICS/PROPULSION INTEGRATION
R E Bower 804-827-3285

An advanced technology base will be developed for subsonic aircraft to improve safety and productivity, lower cost, and reduce performance losses that are associated with integration of propulsion systems and airframes The technology base will be applicable to both military and civil subsonic aircraft, but will be focused on vehicles having operating characteristics and environments of large transport airplanes, commuter aircraft, and general aviation airplanes The research will involve analytical and experimental investigations beginning at the first level of integration (that is, wings-fuselages, wing-nacelles) and progressing toward more complete configurations with the objective to understand the behavior of attached and separated flows and assess the behavior in terms of its impact on performance and stability and control The work will be accomplished through computer analysis, simulator studies, and wind tunnel and flight tests of model and full scale aircraft

Aeronautics Systems Technology Programs
Rotorcraft Systems Technology

W83-70094 **532-01-11**
Ames Research Center, Moffett Field, Calif
ROTORCRAFT FLIGHT GUIDANCE SYSTEMS TECHNOLOGY
J S Bull 415-965-5425
(505-34-11, 532-06-11)

The objective of this research is to provide the critical technology needed to significantly improve rotorcraft operational capability under instrument meteorological conditions (IMC) The program goal is to achieve rotorcraft mission productivity under IMC conditions equivalent to that under visual meteorological conditions (VMC) In accomplishing the program objective and goal, it is expected that system safety will also be enhanced The research program will be based upon the needs, requirements, and operating experience of the sers, in coordination with the DOD, FAA, and industry The design criteria and performance tradeoffs for rotorcraft all weather system concepts will be defined, implemented, and evaluated through simulations, flight research, and operational flight assessments There are three main rotorcraft all weather system technology thrusts (1) the development of design criteria and performance tradeoffs for promising remote site guidance concepts, (2) the definition of operational and performance limitations of curved, segmented, and decelerating rotorcraft approaches to a helipad in proximity to a microwave landing system installation and (3) the development of crew station design criteria for advanced all weather integrated guidance and control system concepts The basic compatibility between the guidance systems and the aircraft performance and control capabilities will be considered in all these activities to properly focus the research

W83-70095 **532-03-11**
Ames Research Center, Moffett Field, Calif
RSRA FLIGHT RESEARCH/ROTORS
W J Snyder 415-965-6570
(532-06-11, 505-42-21)

Research conducted under this program will provide and validate integrated rotor system technology required to substantially improve the performance, utility, efficiency, dynamics, noise, maintainability, and ownership cost of civil and military helicopters The objectives of this RTOP are to provide and validate integrated rotorcraft and rotor systems technology required for the low risk design of advanced rotorcraft systems and components based on verified design tools and experimental methods Program emphasis is on rotor system performance, rotor/airframe aerodynamics and aeroelastic methodology, vibration prediction and control, noise prediction and control, advanced materials application, advanced rotor control concepts, and advanced vehicle concepts which have significant potential gains in utility, efficiency, maintainability, and productivity The activity involves system design studies and focused and coordinated research in analytical prediction methods, simulation, ground testing, and flight testing of current state of the art rotors and advanced concept rotor systems This program is in cooperation with U S Army utilizing the Rotor Systems Research Aircraft (RSRA) and other testbed aircraft as appropriate The flight data base will be expanded on existing rotors that can be readily adapted for evaluation on RSRA (and other rotorcraft) and advanced research rotor systems will be developed for evaluation The development of the RSRA facilities will be completed and operation will be supported

W83-70096 **532-06-11**
Ames Research Center, Moffett Field, Calif
ROTORCRAFT SYSTEMS INTEGRATION
John Zuk 415-965-6568
(532-03-11, 505-42-11)

Research conducted under this RTOP will advance rotorcraft aeromechanics systems technology with an emphasis on improving basic design theory, rotor and rotor/airframe aerodynamics, and aeroelastic characteristics and methodology, vibration prediction and control noise prediction and control, advanced control system concepts, advanced crew station concepts, and advanced vehicle concepts The research involves focused and coordinated programs requiring analysis, wind tunnel model testing, simulation and flight testing These programs encompass civil and military aspects of advanced rotorcraft concepts which will increase performance, efficiency, and productivity, reduce noise and vibration, and improve reliability

W83-70097 **532-06-12**
Lewis Research Center, Cleveland, Ohio
CONVERTIBLE ENGINE SYSTEM TECHNOLOGY
K L Abdalla 216-433-6604
(505-42-32)

Part of the NASA Rotorcraft Program is aimed at advancing technology in engine components, transmissions, and propulsion system integration Objectives are to improve propulsion system durability, reliability, and cruise fuel consumption, to reduce life cycle cost, to develop propulsion technology unique to high productivity vehicles, and to increase operational capability and flexibility The objective of this program is to provide a research tool for the Government to determine the feasibility of and advance the technology for a convertible engine concept for high speed rotorcraft Technology readiness will be demonstrated in an experimental propulsion system incorporating advanced engine concepts Through FY-82, this RTOP was entitled Advanced Rotorcraft Propulsion Technology and included work in basic research and technology in support of rotorcraft vehicles as well as the convertible engine system technology program Beginning with FY-83, the scope of this RTOP has been changed to cover only the convertible engine work The basic rotorcraft R and T work is being covered by the related RTOP

W83-70098 **532-06-13**
Langley Research Center, Hampton, Va
ROTORCRAFT VIBRATION AND NOISE
Robert C Goetz 804-827-2042
(505-42-23)

The objectives of this research are to develop the technology for reducing the interior noise of helicopters through transmission/mainframe isolation, to develop the technology for improving rotor noise methodology and a noise criteria capability through the acquisition of acoustic data and development of noise prediction mehtods, and to verify analysis models for use in prediction of airframe vibrations Contract studies will be performed on rotorcraft interior noise with emphasis on quantifying the noise radiated by the transmission and attenuating this noise by means of isolator systems In the noise prediction area, model and full scale performance and acoustic data will be acquired for the purpose of developing and validating noise prediction methods, and to validate wind tunnel technology for use in determining the performance and noise characteristics of new design rotorcraft A noise prediction system will be designed for rotorcraft use and available data bases will be installed within the system Contracted efforts by the major rotorcraft manufacturing companies will include noise source identification, empirical noise prediction development data base acquisition in laboratories, wind tunnels, and flight and development of noise system components Continued study of finite element modeling will include correlation with ground vibration and flight test with prediction In addition, a rotor analysis model suitable for use in airframe design analysis will be initiated

W83-70099 **532-07-11**
Ames Research Center, Moffett Field, Calif
FLIGHT EXPERIMENTS SUPPORT
F J Drinkwater 415-965-5687
(532-01-11, 532-03-11 533-02-50)

The objective of this effort is to provide overall operations support for Ames research aircraft flight experiments in low speed aerodynamics, flight dynamics and control, guidance and navigation, and avionics systems This support activity consists of aircraft operations and maintenance required to carry out the flight tests, and the operation of ground based facilities which provide data acquisition and processing, aircraft tracking, landing guidance, communications, noise and meteorological measurements, and aircraft instrumentation

W83-70100 **532-08-11**
Ames Research Center, Moffett Field, Calif
SIMULATION FACILITIES OPERATIONS
Anthony M Cook 415-965-5162

This RTOP covers support and operations of the flight simulation facilities at Ames Research Center These facilities consist of the Flight Simulator for Advanced Aircraft, the Vertical Motion Simulator, the Interchangeable Cab Fixed-Base Station, and a Flight and Guidance Laboratory The objective of this RTOP is to provide flight simulation support in research and technology programs for NASA, DOD, FAA, industry and other government agencies in the areas of handling qualities, flight dynamics, control systems, guidance and navigation, cockpit displays, and simulation technology Flight simulation experiments will be related to various types of aircraft and rotorcraft, as well as Space Shuttle vehicles

High-Speed Aircraft Systems Technology

W83-70101 **533-02-11**
Ames Research Center, Moffett Field, Calif
ADVANCED FIGHTER TECHNOLOGY INTEGRATION/F-111 (AFTI-F-111)
L J Caw 805-258-3311

The objective of this program is to conduct a series of experiments to verify in flight the predicted performance gains for the AFTT/F-111 mission adaptive wing The flight experiments will verify the performance of active controls for load alleviation and reduced static stability incorporated in the AFTI/F-111 mission adaptive wing (MAW) aircraft Dryden Flight Research Facility will operate the F-111 aircraft and conduct an investigation of the MAW as a part of the joint NASA-Air Force AFTI/F-111 program Dryden will participate in design reviews, develop and operate instrumentation and define flight test plans

W83-70102 **533-02-21**
Ames Research Center, Moffett Field, Calif
ADVANCED FIGHTER AIRCRAFT (F-15)
E M Kock 805-258-3311

The objective is to provide flight test support for high speed aircraft experiments This will be accomplished by maintaining a baseline capability, with a high performance aircraft, that can be easily used to accommodate specific flight projects or experiments The baseline support will include contractor maintenance support, instrumentation system operation, basic maintenance, and fuel The experiments planned for FY-83 include operability evaluation of the F-100 engine with the digital electronic engine control, an operability evaluation of the F-100 engine model derivative, and an evaluation of the DEEC failure mode accommodation logic

W83-70103 **533-02-31**
Ames Research Center, Moffett Field Calif
F-4C SPANWISE BLOWING FLIGHT INVESTIGATIONS
R G Bryant 805-258-3311

The overall objective is to verify, through full scale flight tests with a modified F-4C airplane, the low speed and transonic performance and the flying qualities improvements predicted by analytical and wind tunnel studies for spanwise blowing This program is a cooperative effort between Ames and Langley Research Centers Factors not readily assessable in the wind tunnel will also be evaluated during the flight tests These include the use of spanwise blowing for improved maneuverability, control of low speed wing rock, alleviation of shock induced separation effects, and improved landing performance Reynolds number and scale effects will be investigated

W83-70104 **533-02-33**
Langley Research Center, Hampton, Va
F-4 SPANWISE BLOWING
P J Bobbitt 804-827-2961

The objective of this research is to verify, through full-scale flight tests, the takeoff and landing and subsonic maneuver performance and flying qualities improvements predicted by analytical and wind tunnel studies for the spanwise blowing (SWB) concept The research will also provide information to define the effects of vehicle configuration and flight regime on the optimum nozzle location, size, geometry, and blowing rate The approach involves wind tunnel tests of an F-4 model in the NASA LaRC 7- by 10 foot high speed tunnel to obtain the necessary data to aid in definition of the flight experiments at DFRC The wind tunnel tests will evaluate an outboard location for the SWB nozzles in addition to the inboard location currently on the airplane Other leading edge devices will also be tested in the tunnel to assess their effectiveness in controlling the leading edge vortex flow

W83-70105 **533-02-41**
Ames Research Center, Moffett Field, Calif
INTEGRATED RESEARCH AIRCRAFT CONTROL TECHNOLOGY (INTERACT)
B M Kock 805-258-3311

The objective is to develop, evaluate, and demonstrate an integrated airframe and propulsion control system This will be accomplished through a flight research program using a suitably modified test airplane In the near term, supporting research activities will be conducted to provide the technology data base leading to the flight program

W83-70106 **533-02-50**
Ames Research Center, Moffett Field, Calif
PROPULSIVE-LIFT TECHNOLOGY - QSRA FLIGHT EXPERIMENTS
J A Cochrane 415-965-5662

Advanced propulsive lift technology has been shown to provide significant improvements to civil and military aircraft operating in CTOL, RTOL, and STOL modes and is of current interest to the military services and the aircraft industry Exploitation of these benefits requires research into parameters affecting performance, flight control systems, stability augmentation, cockpit displays, and operating procedures In addition, operation of aircraft incorporating this technology in either a civil or a military environment requires the development of military specifications, civil certification criteria, and design data for use by procuring agencies regulatory agencies, and the aerospace industry The quiet short haul research aircraft (QSRA) flight experiments program addresses these problems with a multidiscipline flight program using the QSRA equipped with a highly capable digital computer, advanced electronics displays and a programmable head-up display The flight program is supported by a comprehensive simulation and analysis program The program will investigate aerodynamic performance including the application of propulsive lift techniques to CTOL type aircraft to either reduce field length or increase payload at equal field length Flying qualities criteria for highly augmented control modes will be defined and head-up and color display concepts will be investigated for shipboard operations and tactical military missions Operating margin criteria will be defined for highly augmented controls for the approach and landing Contributions to the landing field length will be determined for tactical military and civil operations Real time energy management techniques will be applied for configuration management and flight profile generation for military and civil operations Maneuvering enhancement through the application of propulsive lift will be investigated for civil noise abatement, fuel conservation, and military applications

W83-70107 **533-02-51**
Ames Research Center, Moffett Field, Calif
POWERED LIFT SYSTEMS TECHNOLOGY - HARRIER FLIGHT RESEARCH PROGRAM
Bedford A Lampkin 415-965-6039

The Navy and Marine Corps are scheduled to deliver the Yav-8B Harrier Aircraft to Ames Research Center at the end of FY-83 A flight research program will be conducted with the aircraft at Ames Research Center and at Dryden Flight Research Facility Objectives of the flight research program are (1) to correlate flight measured aerodynamic/propulsion interactions with wind tunnel predictions and simulation model, (2) to provide a data base for control/display concepts for STOVL operations and combat maneuvering, and (3) to establish flying qualities criteria for flight control and display systems A current contract to obtained the conceptual design of research modifications to the aircraft will be concluded in September 1982 Presently, ground support equipment unique to the aircraft is being procured In FY-83, training of flight and maintenance personnel will be conducted, aircraft support contracts will be initiated, and research equipment will be procured as necessary The first phase of flight research will start early in FY-84

W83-70108 **533-02-61**
Ames Research Center, Moffett Field, Calif
AFTI/F-16
C R Jarvis 805-258-3311

The overall objective of the Advanced Fighter Technology Integration (AFTI)/F-16 program is to quantify the benefits and penalties of the individual and integrated technologies proposed to improve weapon system effectiveness and survivability by flight demonstration of air to air and air to surface offensive and defensive mission roles The digital flight control system, automatic maneuvering attack system, and pilot vehicle interface technologies are being implemented in a modified F-16 to allow flight evaluation of such nonclassical control modes as direct lift and side force, flat turn, fuselage pointing, and uncoupled independent control of aircraft rotation and translation The AFTI/F-16 airplane will be flight tested and evaluated by a joint Dryden, USAF, and contractor flight test team and will be operated and maintained by Dryden from Dryden facilities

W83-70109 **533-02-71**
Ames Research Center, Moffett Field, Calif
DECOUPLER PYLON FLIGHT EVALUATION
M R Barber 805-258-3311
(533-02-23)

In order to obtain maximum utilization of fighter aircraft, many different types and combinations of stores are pylon-mounted to the wings The carriage of these stores can result in reduced flutter speeds or flutter placards with a corresponding degradation in mission effectiveness The NASA Langley Research Center (LaRC) has developed a pylon, the decoupler pylon, which suppresses wing/store flutter The decoupler pylon dynamically isolates the wing from the store pitch inertia effects by means of soft-spring and damper elements Static pitch orientation of the store is maintained by a low frequency control system

The decoupler pylon has been shown to be effective in suppressing wing/store flutter by analysis and wind tunnel tests on a rectangular research wing and in transonic wind tunnel test on the F-16 and YF-17 flutter models These results have been very encouraging and NASA has defined a program to flight test the decoupler pylon A feasibility study and conceptual design have been conducted under contract establishing that the decoupler pylon concept can be implemented in flight hardware for testing on the F-16 aircraft General Dynamics Inc is fabricating a decoupler pylon for an F-16 aircraft under contract to LaRC Flight test of the decoupler pylon will be conducted under this RTOP

W83-70110 **533-02-73**
Langley Research Center, Hampton, Va
DECOUPLER PYLON FLIGHT DEMONSTRATION
R C Goetz 804-827-2042
(505-33-43)

A joint program between Langley Research Center and Dryden Flight Research Facility has the objective to demonstrate the suppression of wing/store flutter using the decoupler pylon concept on an advanced high performance airplane The concept has been verified in wind tunnel studies The purpose of the flight studies is to subject the concept to the effects of the full flight environment including maneuvering and atmospheric crusts while assessing the alleviation of the store flutter problem and to evaluate the dynamic characteristics of the wing-store-decoupler pylon system The decoupler pylon is being designed and fabricated under contract to General Dynamics, Ft Worth, Texas, and will be flight tested at the Drygen Flight Research Facility The Langley Research Center will exercise overall management control of the program

W83-70111 **533-02-81**
Ames Research Center, Moffett Field Calif
SUPPORT FOR FORWARD SWEPT WING (X-29A)
Terrill W Putnam 805-258-3311

The objective is to provide technical advisory support, conduct analysis, wind tunnel tests, simulations, ground facility tests, and flight tests in order to discharge responsibilities established in the NASA/DARPA Memorandum of Agreement concerning the Forward Swept Wing Program Dryden will provide technical support through participation in design reviews, independent analysis, ground tests, flight certification and readiness reviews, and through the implementation of a high fidelity real-time piloted simulation at Dryden Dryden will also provide approval of quality assurance plans and will provide proven flight test instrumentation from the Dryden inventory Ames will provide a high fidelity moving base simulation of the X-29A to study approach and landing characteristics

W83-70112 **533-02-83**
Langley Research Center, Hampton, Va
FORWARD SWEPT WING SUPPORT
P J Bobbitt 804-827-2961

The objective of this research is to conduct analyses, wind tunnel tests, simulations, ground facilities tests, and flight tests on the forward swept wing as necessary to explore and evaluate advanced technologies The research will provide high Reynolds number wind tunnel data for correlation with flight data and will support prediction of stall/spin characteristics The approach involves design and fabrication of a X-29A aircraft model for testing in the National Transonic Facility The stall/spin research will include static and dynamic-force tests, dynamic model flight tests, and piloted simulation studies

W83-70113 **533-02-91**
Ames Research Center, Moffett Field, Calif
FLIGHT SUPPORT
B D Axley 805-258-3311

Equipment, maintenance, and operation are provided for (1) support aircraft including (2) F-104N, F-104G, T-38, T-37, C-47, and Bell Helicopter, (2) service aircraft including B-52, PA-30, and JetStar Major effort and coordination of activities is provided by inhouse resources with augmentation by supporting contractors (engine maintenance, AGE maintenance, inventory management), fuel, parts, special support purchased from the military This effort supports research flight programs, providing adequate proficiency of pilots, chase aircraft, R/D support in terms of research investigations and general operational support

W83-70114 **533-03-11**
Ames Research Center, Moffett Field, Calif
HIGHLY MANEUVERABLE AIRCRAFT TECHNOLOGY FLIGHT RESEARCH
H H Arnaiz 805-258-3311

This RTOP covers the flight test phase of a program to provide improved technology for the design of new advanced aircraft, with special emphasis on high maneuverability Normal design practices have been relaxed to permit complete freedom in the application of state-of-the-art technologies such as fly-by-wire digital flight controls, composite structures, digital propulsion controls, improved aerodynamics and the like, in order to obtain maximum benefits from the combined interdisciplinary effects The complex, high-risk technology design of the HiMAT will be validated by demonstrating in flight the transonic maneuverability goal of the vehicle (8g at 9 Mach, 25,000 ft alt) and the supersonic endurance goal (3 minutes at 1 4 Mach, 40,000 ft alt) The high level of technical risks inherent in the HiMAT design precludes their application to manned aircraft due to pilot safety concerns and vehicle costs Free-flying powered 44-scale models controlled by remote piloting techniques will be used to acquire flight test data at minimum costs

W83-70115 **533-04-12**
Lewis Research Center, Cleveland, Ohio
TURBINE ENGINE HOT SECTION TECHNOLOGY (HOST)
Daniel J Gauntner 216-433-5266

The turbine engine hot section technology (HOST) program will develop the analytical tools needed for improving the prediction of the durability of combustor liners and turbine vanes and blades of advanced aircraft turbines HOST will consist of contracted and in-house research efforts of both an analytical and an experimental nature in several technical areas The analytical aspects will include computerized models and predictive tools to describe the service environments and complex loading conditions of these engine components The experimental aspects will provide new input data to the analytical models and will enable demonstration of the validity of the models and their superiority over present methods

Subsonic Aircraft Systems Technology

W83-70116 **534-03-13**
Langley Research Center, Hampton, Va
STRUCTURAL INTEGRATION
H T Wright 804-827-3265
(505-33-33)

The primary objective is to develop technology for and accelerate the introduction of composite material in U S aircraft with focus on wing and fuselage components of military and commercial transports Key technology issues facing the application of composites to wing structure including critical joints, fuel containment, and durability/damage tolerance, will be addressed upon authorization of phase 2 of existing contracts to the major commercial manufacturers The phase 2 program will be augmented with the requirement for evaluation of new toughened resin systems using the standard test procedures (NASA RP 1092) developd during phase 1 Studies (overguideline) will be initiated with commercial and military transport manufacturers to identify critical, long lead technologies which are considered vital to the efficient application of composites to fuselage structure

W83-70117 **534-04-10**
National Aeronautics and Space Administration, Washington, D C
RADIO TECHNICAL COMMISSION FOR AERONAUTICS (RTCA)
Lee D Goolsby 202-755-3003

This RTOP provides for the continuation of support to the Radio Technical Commission for Aeronautics (RTCA) located in Washington, DC The RTCA brings together experts from government, universities, and industrial establishments to advance the art and science of aeronautics through the investigation of present and potential applications of avionics and telecommunications The RTCA and its special committees seek solutions to problems involving the application of electronics, avionics, and telecommunications to aeronautical operations, they frequently recommend technical performance standards and common operational requirements for consideration by Government, industry, and aviation users As a member of the executive committee, NASA's representative can present subjects or problems for discussion and action, authorize new special committees, and approve completed studies Through the mechanism of RTCA, NASA can be kept abreast of aeronautical needs and requirements and can initiate relevant research and participate in development of solutions to common problems with other members of the aviation community

W83-70118 **534-04-13**
Langley Research Center, Hampton, Va
ADVANCED TRANSPORT OPERATING SYSTEMS
A Burgess Malcolm 804-827-2925

The objectives are to define functional requirements and performance criteria for flight systems and displays of the future with which

the pilot can safety and effectively operate in the evolving National Airspace System, to perform more efficient flight with respect to fuel, airspace, and time, to increase traffic flow capacity, and to improve the operational capability in adverse weather The approach will be to investigate concepts to improve exchange of information between air traffic control (ATC) and aircraft throughout the flight profile, identify and promote incorporation of aircraft capabilities in design of ATC improvements to facilitate efficient operations, propose and investigate concepts offering improvements to flight deck design, ATC and aircraft systems, and procedures providing more efficient operations, propose and investigate strategies for optimization of terminal-area air traffic flow, and develop improved takeoff, approach, and landing capabilities Research activity involves analysis, mission simulations, and flight studies using facilities at Langley, Wallops, FAA Technical Center, and FAA-designated controlled airspace Simulation facilities and a modified B-737 airplane, equipped with highly flexible display and control systems, are used to study operating systems, and procedures in simulated future terminal area environments The program includes active participation by major airframe manufacturers and cooperation with the FAA and airline representatives

W83-70119 **534-04-16**
Goddard Space Flight Center, Greenbelt, Md
RESEARCH AIRPORT OPERATION
Donald L Feller 804-824-3411

This RTOP covers the Fiscal Year 1983 Program Support costs associated with OAST programs that use the facilities of the Wallops research airport and other supporting services Included are program aircraft ground servicing, control tower management of the Wallops airport control area, shop support, ADP operations, SAR, chase, and other aircraft flight services, crash, fire, and rescue services, specialized instrumentation and miscellaneous equipment

Advanced Propulsion Systems Technology

W83-70120 **535-01-12**
Lewis Research Center, Cleveland, Ohio
ENERGY EFFICIENT ENGINE PROJECT
C C Ciepluch 216-433-6644

The objective of the Energy Efficient Engine project is to develop and demonstrate technology for a next generation turbofan engine having 10 to 15% lower specific fuel consumption, at least a 50% reduction in rate of performance deterioration, at least 5% reduction in direct operating cost, and reduced emissions and noise levels as compared to current high bypass turbofan aircraft engines Initial program efforts included preliminary engine design and integration studies through contracts with two major aircraft engine manufacturers On the basis of these studies and associated airframe and airline evaluations, engine cycles and configurations that best meet project goals were identified The major part of the project was then initiated with award of parallel component development and integration contracts to the same two engine companies These latter contracts emphasize the advancements in component and systems technologies required for possible future commercial development of more energy efficient engines Advanced engine components are being designed and developed, and performance is being verified by rig tests The high spool core system is being designed, fabricated, and will be tested to evaluate its performance characteristics and to further refine the design of the components The low spool assembly integrated with the core will be used to evaluate two spool integrated performance and mechanical systems performance

W83-70121 **535-03-11**
Ames Research Center, Moffett Field, Calif
ADVANCED TURBOPROP-INSTALLATION AERODYNAMICS
L L Presley 415-965-5851

The objective of this research is to develop the technology required to demonstrate the feasibility of advanced turboprop transport aircraft capable of cruise speeds up to 0 8 Mach number and altitudes above 35,000 feet System studies will analyze specific aircraft design tradeoffs These studies will help determine the aircraft installation trades regarding cruise speed, engine location, propeller characteristics, etc , and thereby identify promising directions for future research A combination of theoretical and experimental studies will be conducted to define the aerodynamic technology required to intergrate advanced turboprop propulsion systems with transport aircraft using supercritical wing technology Detailed flow interactions among the propeller slipstream, nacelle, and wing surface will be examined and methods to optimize the installation identified Theoretical analyses use existing linar methods and include the development of advanced methods capable of handling the transonic slipstream-nacelle-wing interactions Experimentally, the flow interactions are investigated using powered semispan models to provide an accurate simulation of the actual flow conditions In addition, several two foot diameter scale models of advanced high-tip-speed propellers are tested on a JetStar aircraft capable of flying Mach 0 8 at 35,000 feet altitude Microphones placed on the wing and fuselage are used to obtain near field noise data for acoustic research Data from these flight tests will be analyzed and correlated with prediction codes

W83-70122 **535-03-12**
Lewis Research Center, Cleveland, Ohio
ADVANCED TURBOPROP PROGRAM
G K Sievers 216-433-4000
(505-40-32)

The objective of the Advanced Turboprop Program is to develop propeller and related drive system and aircraft technologies critical to efficient, reliable, and acceptable operation of advanced turboprop (prop-fan) powered aircraft The present phase 2 effort (large scale structures) described by this RTOP, was initiated in FY-81 and is scheduled to be funded thru FY-85 The primary emphasis under this phase is the design, fabrication, and ground test of an advanced large scale propeller of 8 to 10 feet in diameter powered by an available gas turbine engine with a modified existing gearbox Supporting analysis and testing work is planned in the areas of propeller aerodynamics, acoustics, structures, dynamics, and in aircraft cabin environment (noise and vibration) and aircraft installation aerodynamics Studies of advanced turboprop propulsion systems and components, and of advanced turboprop aircraft, missions and applications, are also planned Although NASA Lewis hs overall management responsibility for the Advanced Turboprop Program, other field centers will manage and conduct portions of the program that lie within their areas of capability and expertise The major efforts planned by other centers are the measurement installed aerodynamic performance (ARC), the inflight measurement of near field propeller noise (DFRC), and investigation of fuselage designs for low cabin noise with minimum weight penalty (LaRC) It is intended that the present phase 2 program lead to the final phase 3 effort (systems integration) where the propeller and propeller drive system generated by the phase 2 effort will be tested in flight using a specially modified test bed aircraft

Space Research and Technology Base

Fluid and Thermal Physics Research and Technology

W83-70123 **506-51-11**
Ames Research Center, Moffett Field Calif
COMPUTATIONAL AND EXPERIMENTAL AEROTHERMODYNAMICS
V L Peterson 415-965-5265
(506-51-41, 505-31-01, 506-54-11, 506-53-31, 506-63-35 506-63-36)

The objective is to establish aerothermodynamic technology and configuration design concepts to improve vehicle safety, reliability, versatility, and aerodynamic efficiency with maximum payload for Earth-orbital missions and planetary exploration Advanced computational methods and computer codes will be developed for predicting vehicle flow fields and performance Turbulence models (used in these computer codes) will be developed from 'building block' numerical and physical experiments Aerothermodynamic studies will be performed of aero-assisted orbital transfer vehicles and advanced maneuvering vehicle concepts Data analysis for space shuttle experiments (OEX) will be performed including infrared image of the shuttle (IRIS), title gap heating and catalytic surface effects New instrumentation techniques will be developed for the measurement of turbulence quantities in 3-dimensional flow fields The use of the Shuttle Entry Air Data System (SEADS) will be investigated at subsonic and transonic speeds by the Dryden Flight Research Facility Aerodynamic data for reentry flight conditions will be obtained and used to extend the available data base to space shuttle reentry conditions

W83-70124 **506-51-13**
Langley Research Center, Hampton, Va
ENTRY VEHICLE AEROTHERMODYNAMICS
G D Walberg 804-827-3887

The objective of this effort is to improve the fundamental understanding of aerodynamic and aerothermodynamic flow phenomena on entry

vehicles in the continuum, transitional, and rarefied flow regime Results of this research will permit significant advances in future space transportation vehicle capabilities, reliability, versatility, and efficiency The intent is to conduct fundamental and applied research using ground-based and flight experiments and analytical techniques to expand the data base and associated technologies beyond that established for the space shuttle Specific studies will be directed toward the solution of aerothermodynamic problems associated with future Earth-to-orbit and orbit transfer vehicles (OTV) including aerodynamic performance, viscous-interaction and real-gas effects, vortex interaction, heat transfer, basic configuration shaping, and optimization Emphasis will be given to the development of computational techniques for the prediction of aerodynamic performance of OTV's in the rarefied flow regime These techniques will have useful application to studies of contamination due to propulsion exhaust products and to prediction of space station drag

W83-70125 **506-51-23**
Langley Research Center, Hampton Va
DETAILED AEROTHERMAL LOADS
R C Goetz 804-827-2042

The primary objective of this effort is to identify and understand flow phenomena and flow/surface interaction parameters required to define detailed aerothermal loads for structural design The secondary objective of this effort is to develop and validate analysis and test methods for the prediction and verification of structural response in thermal environments for use in the support of design, optimization, and qualification of space transportation systems Effects of wavy surfaces, coves, gaps, protuberances, wing/body and wing/elevon junctions will be studied in wind tunnel tests Selected problems will be studied analytically Some effort will also be focused on mass addition cooling effects on flow phenomena with initial emphasis on conical shapes

W83-70126 **506-51-41**
Ames Research Center, Moffett Field, Calif
THERMO-GASDYNAMIC TEST COMPLEX
F H Nichols, Jr 415-965-6075
(505-31-01, 506-51-11, 506-53-31, 506-63-36)

This RTOP covers support and operation of the high energy facilities at Ames which include the Arc-Jet Complex (Aerodynamic Heating Tunnel, 2x9 Turbulent Flow Duct, 20-MW Panel Test Facility, 60-MW Interaction Heating Facility, Transitional Flow Facility, High Enthalpy Entry Facility, Giant Planet Facility, High Power Gas-Dynamic Laser), 3 5-Ft Hypersonic Wind Tunnel, High Reynolds Number Channels I and II Ballistic Range Facilities, and the Electric Arc Shock Tube Facility The objective of this effort is to provide aerodynamic and thermal testing in support of research and technology programs for NASA, Department of Defense, other government agencies, and industry Program areas supported include generic research applicable to spacecraft thermal protection systems, planetary entry aerothermodynamics, fluid dynamics (including boundary layers) and experimental verification of various computational codes Development, enhancement, and verification tests of the space shuttle thermal protection system is extensively supported, and the thermal protection system for the Galileo and OEX materials evaluations are also extensively supported Experimental verification of 2D and 3D fluid dynamics computer codes and turbulence modeling codes is a major testing effort In addition, tests are performed for systems technology programs including advanced thermal protection systems, nuclear power pack safety, laser hardening of missiles, and the MX missile system

Materials and Structures Research and Technology

W83-70127 **506-53-11**
Ames Research Center, Moffett Field, Calif
SURFACE PHYSICS AND COMPUTATIONAL CHEMISTRY
J O Arnold 415-965-6209
(505-37-21)

The objective is to develop understanding of the mechanisms which control important properties of matter over a wide range of environments This understanding is leading to the development of new materials and processes needed by the agency Work is proceeding in the areas of surface physics and computational chemistry In surface physics, properties of metallic interfaces are being determined by probing their structure at the atomistic level High lateral and depth resolution chemical analysis by Auger electron spectroscopy is used to measure the compositional structure of high temperature metallic corrosion scales Knowledge of surface/environment interactions is being improved by studying chemisorption and surface reactions on microscopic (single crystal) and macroscopic (cluster) metal surfaces Work is underway on the interaction of electron beams with gaseous adsorbates on well-defined metal surfaces In computational chemistry, the physical and chemical properties of molecules and small atomic clusters (5-14 atoms) are being calculated using state-of-the-art wave function computer codes These quantum mechanical results for the small atomic clusters are extrapolated by classical mechanics to determine surface and bulk properties of materials Improvements in precision, code optimization, and approximate methods are allowing larger systems to be studied, thus requiring smaller extrapolations to obtain surface and bulk properties This also helps to elucidate the manner in which properties of atomic clusters approach those of the bulk material These calculations are currently being used to investigate (and/or) model crack initiation and propagation, chemisorption, diffusion, corrosion, catalysis and internal rotations of polymer chains

W83-70128 **506-53-12**
Lewis Research Center, Cleveland, Ohio
NON-DESTRUCTIVE EVALUATION AND TRIBOLOGY
C Lowell 216-433-6922
(506-33-12, 506-33-32)

The objectives of this RTOP are to develop greater understanding of materials with aerospace propulsion and power potential and to develop guidelines for improving their physical/mechanical properties and reliability Fundamental studies are aimed at investigating mechanical and other factors that limit material reliability, performance, and useful life Fundamental studies are also aimed at identifying scientific concepts that might be applied to substantially improve aerospace materials The research includes Part A - material properties/performance enhancement via innovative application of nondestructive evaluation concepts/models for characterization of microstructure and extrinsic properties, and Part B - understanding of the basics of friction, wear, adhesion, thin film liquid lubrication, and the chemistry and morphology of solid lubricants

W83-70129 **506-53-15**
Jet Propulsion Laboratory, Pasadena, Calif
FUNDAMENTALS OF MECHANICAL BEHAVIOR OF COMPOSITE MATRICES
A Gupta 213-354-5783

The long term objective of this RTOP is to develop a fundamental understanding at the molecular level of the behavior of polymers with major emphasis on candidate composite matrix materials including both thermosetting and thermoplastic polymers For thermosetting polymers, the FY-83 objectives are to complete the studies of the curing kinetics to characterize the network topology and molecular relaxation mechanisms as well as viscoelastic properties, leading to an understanding of structure-property relationship For thermoplastics, the objectives in FY-83 are to determine the effect of physical aging processes on the molecular relaxation mechanism of polymethyl methacrylate (PMMA) and to identify a candidate polyimide for studies of molecular deformation mechanisms and mechanical properties of high performance thermoplastic matrix materials For thermosets the approach will involve thermal and spectroscopic studies of the curing reactions, sol/gel analysis of the cured polymers, and stress-optical characterization of molecular and mechanical response as a function of temperature and frequency For thermoplastics, the approach involves characterization of the simultaneous response of stress-strain and birefringence of a model thermoplastic with a controlled aging history

W83-70130 **506-53-17**
Lyndon B Johnson Space Center, Houston, Tex
REFINING OF NONTERRESTRIAL MATERIALS
R J Williams 713-483-2781

These studies are designed to provide data on chemical and physical processes which might be used to extract metals, minerals, and glasses from lunar rocks and soils for ultimate use in constructing and supporting space projects Laboratory experimentation will be used to study some processes by which potentially useful materials may be extracted from lunar rocks and soils These studies will be confined to the laboratory scale at the bench-top and will concentrate on the determination of basic physical properties which define and quantify processes Our specific efforts are focused on the separation of analogs of lunar soils into their constituent mineral phase using electrostatic and magnetic techniques

W83-70131 **506-53-23**
Langley Research Center Hampton, Va
COMPOSITES FOR ADVANCED SPACE SYSTEMS
R C Goetz 804-827-2042
(505-33-33 505-33-23)

The objective of this research is to define and develop composite materials that have the potential of improving the performance and reducing the costs of space structures and space transportation systems Current emphasis is being placed on establishing the performance

capability of composites materials in the radiation environment of space, continued development of high temperature polymer composites and thermal control coatings, and understanding the mechanical behavior of composites to improve their damage tolerance Current and advanced resin matrix composites will be subjected to laboratory simulated space radiation (proton, electrons, UV, etc) to establish overall composite material performance and to identify radiation damage mechanisms These studies will serve as a guide to develop models to predict material performance in the space environment and to evolve more radiation resistant materials A basic understanding of the cure mechanics of high temperature composites will be established to provide for optimum and reproducible fabrication of structural components A generic methodology will be established for prediction of the fracture strength of composites along with concepts and analyses to achieve improved damage tolerance such as the use of buffer strips A significant portion of this research is directly related to Large Space Antenna Technology Focus established at Langley

W83-70132 **506-53-25**
Jet Propulsion Laboratory, Pasadena, Calif
EFFECTS OF SPACE ENVIRONMENT ON COMPOSITES
A Gupta 213-354-5783

The long range objective is to utilize ultrafast pulse radiolysis to gain an understanding of primary degradation processes caused by charged particles and high energy ultraviolet radiation in composite materials, and to ultimately use this information (along with conventional high energy exposure material test data) to develop a reliable methodology for estimation of the long term effects of space environment on polymers and composites The objectives for FY-83 are to complete development of the energy deactivation model for TGDDM/DDS-based epoxy, to initiate studies of the effects of high energy ultraviolet radiation on candidate materials and to continue electron and proton pulse studies on polyimides and other candidate systems The effect of charged particles on the long-term stability of the fiber-matrix interface will also be investigated, starting in FY-83 Transient measurements utilizing fast optical and ESR detection assemblies, following pulse radiolysis or UV excitation, will be used to determine rates of fast processes such as dissociation of primary intermediates, generation and decay of excited states resulting from ion recombination or other secondary processes, and radical formation and dissappearance These data, along with conventional steady state data, will be used to develop analytical models of degradation and a reliable prediction technology for 20-year lifetime applications

W83-70133 **506-53-26**
Goddard Space Flight Center, Greenbelt, Md
ELECTRICALLY CONDUCTIVE THERMAL CONTROL COATINGS
John H Henninger 301-344-5309

The objective of this RTOP is to develop advanced conductive thermal control coatings and coating techniques The needed advancements have been established by consultation with industry, thermal design, experiment, and materials personnel The proposed work is divided into three main categories Capabilities and facilities for development, evaluation, and qualification efforts are all currently active within the proposing Goddard Space Flight Center (GSFC) organization The final products of this program will be definitive procedures and data for the preparation of coatings for space flight use, permitting private industry to act as suppliers The research will investigate the development of composite vacuum deposited coatings on relatively thin, 0 1 mil or less, polyamide films using several vapor deposition techniques The final coating will be tailored to yield high solar reflectance and thermal emittance values to produce low alpha/epsilon ratios and with known sensitivity to contamination New vacuum deposition procedures for enhancing the utilization of electrically conductive and transparent indium oxide coatings will be developed The use of RF ion plating techniques and plasma tube ionization in conjunction with varying glow discharge rates will be evaluated Finally, existing GSFC formulations and applications relating to electrically conductive inorganic paints will be modified The approach taken will be to optimize pigment size, improve vehicle conductivity at low temperature, and improve pigment firing procedures

W83-70134 **506-53-27**
Lyndon B Johnson Space Center, Houston, Tex
HYPERVELOCITY IMPACT RESISTANCE OF COMPOSITE MATERIALS
D J Kessler 713-483-2956

Composite materials are being used in spacecraft structures on an increasing scale In orbit, these materials may be exposed to hypervelocity impacts with meteoroids and space debris at relative velocities of 20km/sec and 10km/sec respectively Past research has defined the hypervelocity impact resistance of aluminum alloys, but little or nothing is known about the properties of composite materials A series of tests are planned to define the hypervelocity impact properties of a number of composite materials and some simple structures made of the composites The results of these tests will be compared with prior results for aluminum alloys, and engineering design criteria will be developed for the use of composites in structures exposed to the meteoroid/debris environment First, a series of screening tests will be done, using a small light gas gun to impact small projectiles on thin sheets of material Several materials will then be selected for more intensive tests, using a large light gas gun to impact projectiles up to 2cm diameter at 10 km/sec on thickness of material significant for spacecraft construction, as well as on some simple structures (as tanks) made of composite materials

W83-70135 **506-53-29**
Marshall Space Flight Center, Huntsville Ala
SPACE DURABLE COMPOSITES AND THERMAL CONTROL SURFACES
R L Gause 205-453-1500
(506-53-23)

The objective of this RTOP is to provide advanced materials technology that will be necessary to assure successful development of future spacecraft, large-area space structures, and advanced space transportation systems Major areas of investigation include extending environmental durability of materials to at least 10 years in both LEO and GEO, increasing durability and/or repairability of thermal control coatings, identifying significant damage mechanisms that degrade composite materials, and evaluating new and improved composite matrices and fibers for resistance to environmental damage mechanisms The approach will be to select candidate composites for exposure, analysis, and evaluation, develop an environmental test matrix for these composite materials from the materials requirements, and perform and appropriate test program to acquire the relevant data Radiation damage mechanisms in polymetric matrix materials will be identified through exposure to simulated space environment conditions and radiations Preliminary development of the methodology for accelerated testing of both polymeric matrix and metal matrix composites in the simulated space environment will be initiated Thermal control surfaces technology will be developed to provide longer lifetimes, increased performance, on-orbit servicing, and improved particulate and contamination resistance

W83-70136 **506-53-31**
Ames Research Center, Moffett Field, Calif
THERMAL PROTECTION SYSTEMS MATERIALS AND SYSTEMS EVALUATION
H K Larson 415-965-5369
(506-51-11, 506-51-41, 506-63-36)

The objective is to provide thermal protection systems (TPS) concepts and materials for heat shields to protect earth and planetary entry vehicles and planetary probes during atmospheric entry The specific objectives are to develop improved materials and minimum weight TPS to enhance the space shuttle and enable fully reusable advanced space transportation systems development develop planetary probe heat shield materials and determine methods to minimize heat shield weights, develop concepts and heat shield materials for safe earth entry of radioactive power sources, support DoD requirements, develop concepts and materials for orbital transfer vehicle, advanced military spacecraft and solar probe heat shields The system requirements for each end use are defined Thermal protection material parameters are determined that meet these requirements Materials are either selected from the extensive technology in existence or new materials with optimized properties are developed Candidate thermal protection concepts and materials are subjected to systematic analysis and testing to quality them for the defined end use Extensive unique Ames arc plasma test facilities developed for space shuttle and planetary entry probes are used in the experimental evaluations Analytical studies are performed utilizing unique enviromental computer codes developed by ARC that include detailed models of both the aerothermal environment and material response to obtain in-depth understanding of the material characteristics Materials are often developed as a result of these studies to meet the ever more stringent requirements for atmospheric entry thermal protection

W83-70137 **506-53-33**
Langley Research Center, Hampton, Va
THERMAL PROTECTION SYSTEMS FOR EARTH-TO-ORBIT STS
R C Goetz 804-827-2042
(506-53-43, 506-51-23)

The objectives of this research are to provide thermal protection systems (TPS) materials and concepts for advanced space transportation systems that provide improved durability and operational costs compared to the current LI-900 and LI-2200 reusable surface insulation systems Heat shield testing support to the current STS program will be provided

High strength advanced carbon-carbon (ACC) sheet material with an improved coating will be developed Ti, superalloys, and ODS alloys will be exposed to simulated shuttle entry environments to determine dynamic oxidation resistance, emittance stability, and strength retention A major objective will be to develop an understanding of the stability and emittance of oxides that form on the surface of high temperature alloys in an oxygen deficient environment Concepts research includes metallic pre-packaged and ACC post-supported standoff concepts These concepts will be evaluated in various Langley high temperature wind tunnels and will be subjected to other types of tests such as foreign object impact and radiant heating Arc tunnel and other facilities will be used as required to validate and certify TPS for multimission use

W83-70138 **506-53-37**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED CARBON-CARBON PANELS
D M Curry 713-483-2375

This RTOP provides for the design, development, and evaluation of carbon-carbon panels for both general acreage and specific high temperature areas of the shuttle orbiter The advanced carbon-carbon material developed by the Vought Corporation under a NASA Langley contract will be used as the baseline material Under previous RTOP funding, an advanced carbon-carbon (ACC) stand-off panel has been designed and fabricated for the area between the orbiter nose cap and nose landing gear door using the ACC material The results of these RTOP studies will evaluate the advanced carbon-carbon panels with respect to the baseline obiter reusable surface insulation (RSI) thermal protection system (TPS) in terms of weight, cost, performance, and maintainability, and form the basis for studies of the application of ACC TPS to orbital transfer vehicles and future launch/entry vehicles

W83-70139 **506-53-40**
National Aeronautics and Space Administration, Washington, D C
ADVANCED SPACE STRUCTURAL CONCEPTS
Sam Venneri 201-755-3277

The objective of this RTOP is to provide a fundamental research program to obtain an understanding of the effective use of space vehicles and exploration of space The program will concern itself with novel tructural forms, human productivity in space, and maintenance of the geometric tolerances of large space structures

W83-70140 **506-53-43**
Langley Research Center Hampton, Va
ADVANCED SPACE STRUCTURES
R C Goetz 804-827-2042

Research will be performed on structures for future spacecraft including platforms, antennas, and space station and for future space transportation systems In-house, deployable and erectable structural concepts and associated design technology will be developed for large platforms and antennas Folding and packaging techniques for very low-mass deployable structures will be investigated Effects of using very slender members to achieve high packaging efficiency will be evaluated, and a slender-member truss structure will be constructed for static and dynamic tests Studies of achievable accuracy will be conducted Under contract, development of the Maypole Hoop/Column Deployable Antenna will continue by designing, building, and testing a 15-meter kinematic model Space station structural research will include assessment of state-of-the-art in analysis for structural dynamics and control of multi-body configurations In-house and contract research on structures for future space transportation systems will include fabrication of test panels for cryogenic tankage and small component testing of advanced carbon-carbon structure

W83-70141 **506-53-45**
Jet Propulsion Laboratory Pasadena, Calif
ADVANCED SPACE STRUCTURES ANTENNA TECHNOLOGY DEVELOPMENT
R E Freeland 213-354-3540

The long range objectives of this RTOP are to (1) develop the offset wrap-rib deployable antenna concept to the point of technology readiness for classes of potential applications, (2) develop the analytical capability of JPL for the prediction of antenna performances for purposes of understandng the basic concept, and determining the potential of the concept for different applications, (3) perform development testing of hardware for verification of the analytical tools and the identification of deficiencies in the analytical or experimental techniques, and (4) support the development of candidate system level configurations to help focus the conceptual development The technical approach is based on the following tasks (1) establish the practical limits of performance for the wrap-rib deployable antenna concept, (2) formulate a technology development program that is responsive to the potential user community, (3) support NASA and DOD sponsored system studies based on the offset wrap-rib antenna concept, (4) demonstrate antenna concept technology readiness using a 55-meter diameter proof of concept hardware model that will be ground tested to demonstrate antenna deployment, and validation of analytical performance prediction models, (5) develop preliminary design for a full scale antenna of 100-meters in diameter, based on the experience gained from the design, fabrication, assembly and testing of the proof of concept hardware along with analytical estimates of antenna performance based on validated models, (6) develop the analytical capability of quickly and cost effectively predict the on-orbit static and dynamic stability of the reflector surface and its alignment with respect to the feed support structure, (7) perform antenna component or model testing to determine the static, dynamic, and thermal characteristics for correlation with the analytical models, and (8) develop approaches and techniques for improving the reliability and accuracy of analytical performance predictions of large very flexible antennas

W83-70142 **506-53-51**
Ames Research Center, Moffett Field, Calif
STRUCTURES ANALYSIS AND SYNTHESIS
A L Carter 805-258-3311

Experimental data from flight and laboratory tests of high temperature structures will be obtained and used to (1) develop strain gage load measurement techniques for high speed flight vehicles, (2) evaluate state-of-the-art analytical methods for high speed flight vehicles, and (3)demonstrate new structural concepts for high speed flight vehicles

W83-70143 **506-53-53**
Langley Research Center, Hampton, Va
ANALYSIS AND DESIGN
R C Goetz 804-827-2042
(505-33-53)

The technical objectives are (1) to develop advanced structural and thermal analysis methods for predicting the nonlinear behavior of aerospace structures under mechanical and thermal excitations, (2) to develop mathematical algorithms for multidisciplinary optimization methods for aerospace structures, (3) to develop and validate analysis and test methods for the prediction and verification of structural response in dynamic, acoustic, and thermal environments for use in the support of preliminary and advanced design, optimization, and qualification of space transportation systems and payloads, spacecraft, and platforms, (4) to accomplish validated capability to control excessive responses of large flexible space structures by active and passive methods, (5) to develop new analytic methods for predicting the coupled structural dynamics and control of multi-body space station configurations, and (6) to develop structural analysis methods for predicting the nonlinear behavior of aerospace structures The work will be accomplished through in-house efforts with both contract and grant support

W83-70144 **506-53-55**
Jet Propulsion Laboratory, Pasadena, Calif
SPACE VEHICLE DYNAMICS METHODOLOGY
J A Garba 213-354-2085
(323-52-41)

The objectives of this effort are to identify, develop and demonstrate techniques for the improvement of low frequency dynamic payload response predictions, to advance methods for the correlation of analysis with test data and to identify the requirements for research for future missions The methods will be verified using flight data wherever possible To meet these objectives new methods for predicting upper bound spacecraft member loads will be sought, existing methods for upgrading analytical models will be evaluated the criteria for analysis/test correlation will be evaluated, and test data for a real complex shuttle will be obtained using several different techniques Other objectives are to develop new methods for the analysis and synthesis of large complex structural systems, advance the state-of-the-art in nonlinear and dynamic analysis of structures, develop methods for the identification of structual parameters To meet these objectives the development of highly efficient techniques for structural optimization using the ACCESS-3 computer code will be continued Several refinements to increase operational efficiency will be implemented and new capabilities, such as additional finite elements, will be added In future years it is planned to exploit recent advances in computer technology to improve the operational efficiency of ACCESS-3 Prof L A Schmit of UCLA will serve as a consultant The activities will be coordinated with personnel at LaRC who are engaged in complimentary tasks

W83-70145 **506-53-56**
Goddard Space Flight Center, Greenbelt, Md
PAYLOADS DEFINITION METHODS
J P Young 301-344-8284
(506-63-36)

The objectives are to develop the capability to simulate the structural and control system dynamics behavior of large multibodied space stations, develop advanced techniques for thermal analysis of space stations, produce improved techniques for deriving vibroacoustic, transient, and related combined environment criteria for STS payloads and develop the technology required to monitor in service structural integrity of large space systems (LSS) The DISCOS system dynamics analysis program will be enhanced to provide capabilities needed to support design of space stations Enhancements will be in areas of absolute acceleration computation, modal representation of multiple/hinge connected bodies, and more efficient time domain solution New capabilities will be developed to rapidly generate FORTRAN simulations of nonlinear controllers and generate reduced order equations Studies will be conducted to advance thermal analysis techniques in the areas of thermal mode analysis, radiation exchange factor computation, and translation from a thermal finite element model to a nodal model The VAPEPS and PACES programs will be exercised and validated The relative importance of vibroacoustic and liftoff low frequency transient induced loads on payload design will be evaluated Formulate technology development guidelines for on orbit NDE, organize a workshop on LSS oriented NDE, and produce a LSS test model for use in a round robin development effort

W83-70146 **506-53-59**
Marshall Space Flight Center, Huntsville, Ala
SPACE VEHICLE STRUCTURAL DYNAMIC ANALYSIS AND SYNTHESIS METHODS
R S Ryan 205-453-2481

The objective is to reduce the high costs and schedule delays due to structural dynamic response phenomena during the development of future spacecraft Dynamics considerations have been critical for several recent NASA projects and are expected to be even more critical for future projects due to fundamental physical principles Four tasks, both ongoing and new, are proposed for the development of improved prediction methods including The development of improved structural and fluid dynamic analysis capability, establish acoustic environmental accuracy requirements for response determination, develop load combinations for design of STS payload components, and investigate the properties of classical modes, complex modes, modes with closely spaced frequencies, and identification of modes from tests Task 1 Improved Structural and Fluid Dynamic Analysis Capability -- continued development of analysis methods to improve capability and usability The SPAR program is the basis of this work Task 2 Acoustic Environmental Accuracy Requirements fo Response Determination -- The present program SAIPEN will be extended to provide payload response PSD prediction capability The Statistical Energy Analysis method is used Task 3 Load Combinations for Design of STS Payload Components -- Present methods are over conservative and no industry-wide standard exists Very significant payload improvements should be possible Task 4 Modal Modeling and Testing -- An investigation into the properties of classical modes, complex modes, modes with closely spaced frequencies, and identification of modes from tests

Computer Science and Electronics Research and Technology

W83-70147 **506-54-11**
Ames Research Center, Moffett Field, Calif
PHOTOPHYSICS AND OPTICAL INFORMATION PROCESSING
R L McKenzie 415-965-6158
(506-51-11)

The general objectives are (1) to incorporate modern laser technology and photophysics in a program to develop nonintrusive techniques for the characterization of gaseous media in a dynamic state, are (2) to develop and evaluate optical computer processors and nonlinear fiber optics for advanced information processors to enable new space experiments, onboard processing, and higher information and data transfer for space applications using integrated optical techniques Activities will include (1) the measurement of turbulent fluctuations in the state variables of cold transonic and supersonic wind tunnel flow, (2) the spectroscopy of small molecules important in the photodiagnostics of cold air flows and combustion processes, (3) the development of a programmable matrix mask for optical computing, (4) the development of optically nonlinear fibers for the infrared beyond microns, (5) the demonstration of frequency doubling in the 5 micron region, and (6) the summing of 5 micron radiation into the visible for ultra-sensitive high-bandwidth detection of infrared photons The change in scope in FY-83 is the work toward the development of the programmable matrix mask which is the key element in a usable optical computer

W83-70148 **506-54-12**
Lewis Research Center, Cleveland, Ohio
SUBMILLIMETER & OPTICAL PROCESSING DEVICE RESEARCH
F Teren 212-433-4000
(506-54-42, 505-40-52, 505-34-02)

The overall objective is to conceive and demonstrate techniques for high-speed numerical calculation using electro-optic technology Specific objectives include high-speed solution of matrix equations with a hybrid electro-optical processor, and laboratory demonstration of selected concepts for an all-digital optical processor Work is conducted through University grants and in-house analysis and experiments Laboratory experiments are conducted using commercially available hardware such as acousto-optic modulators and liquid crystal light valves An in-house design study of fast-response spatial light modulators will be conducted Another objective of this RTOP is to provide through research, design data and developments of materials and methods, the technology base for the development of voltage tunable local oscillator sources, capable of approximately 1 milli-watt output in the frequency range between 600 to 2000 GHz

W83-70149 **506-54-13**
Langley Research Center Hampton, Va
SOLID STATE & OPTICAL DEVICE RESEARCH
R L Stermer 804-827-3535

The objective is to explore and develop novel concepts in advanced solid state and optical devices to enhance data transfer, storage, and real-time data processing to meet electronic system requirements for projected aerospace systems Emerging data systems concepts to meet the operations and control requirements of a large space station and other proposed aerospace systems are to be used as guidance in developing devices Special emphasis will be on developing advanced electronic and optical devices which will enhance system performance, and expandability/adaptiveness in a cost effective manner A balanced approached to obtain the advantages of in-house research, grants, and research contracts is to be used Theoretical and experimental investigations of device concepts, materials, and processing techniques will be conducted in-house Contractual efforts will be used to develop the device concepts and technologies to a level of practical demonstration This complementary effort of in-house and contractual research is to be supplemented with university research to provide the scientific base to predict device performance over a wide range of applications

W83-70150 **506-54-15**
Jet Propulsion Laboratory, Pasadena, Calif
ELECTRONICS RESEARCH AND TECHNOLOGY
H Pickett 213-354-6861
(506-54-25)

This RTOP has the objective of developing enabling technoloy for NASA thrusts and missions in the areas of lasers, solid state devices and optical processors The following sub-tasks support this objective (1) submillimeter components development of quasi-optical technique, radiation coupling method, efficient non-linear devices and local oscillators and demonstration of the resultant receiver systems, (2) diffraction radiation generator demonstrate feasibility of the DRG as a coherent, tunable source of near and submillimeter radiation, (3) UV laser spectroscopy study reactions in laser plasmas for developing new laser sources for remote sensing of atmospheric gases, phytoplankton and mineral species using laser spectroscopy, (4) electron impact spectroscopy generate laboratory data for electron collision processes pertinent to laser and plasma devices, (5) electron impact emissions measure optical emission cross sections, oscillator strengths, dissociative attachment and ionization cross sections for atoms and molecules of interest, (6) fundamental electronics advanced techniques are developed to correlate chemical processing with degradation and basic reliability problems affecting the use of LSI & VLSI circuits Devices using superlattice structures are explored using surface analytical techniques, (7) SAR processor develop compact, high throughput data processing devices and systems utilizing coherent optical elements, (8) parallel optical processor discover, evaluate, and develop concepts for optical processors that can be used to manipulate large streams of data and provide solutions to control equations in real-time, and (9) optical processing materials and devices MBE strained layer superlattice structures fabricated by MBE in InGaAs will be investigated for integrated optics devices applications

W83-70151 **506-54-16**
Goddard Space Flight Center Greenbelt, Md
ACOUSTO-OPTIC & SUBMILLIMETER DEVICE TECHNOLOGY
M Mumma 301-344-6994
(506-54-26 506-54-46 405-02-02, 188-41-55)

Acousto-optic techniques will be developed for use in tandem with heterodyne receivers as widebandwidth IF spectrometers Integrated optics acousto-optic spectrometer will be procured and studied and its suitability as an IF spectrometers will be evaluated Bulk Bragg cell AOS will be constructed and tested in a ruggedized form, as a first step in evaluating its usefulness as IF spectrometers Compact, high resolution, submillimeter wave heterodyne spectrometers for astronomical and atmospheric science applications will be developed

W83-70152 **506-54-17**
Lyndon B Johnson Space Center Houston Tex
PROGRAMMABLE MASK TECHNOLOGY
Harry Erwin 713-483-3669

Optical processing systems offer significant advantages for high speed parallel processing of data needed to support present and future NASA missions and thrusts The inherent parallel nature of light makes high speed, small integrated, optical processors possible The immediate objective of the proposed effort is to develop reliable liquid crystal light valve (LCLV) devices to achieve accurate and faster spatial modulation for the optical cross correlation processing data At the present time, gallium arsenide and silicon have been used to demonstrate the feasibility of the LCLV devices The effort under this RTOP will be directed to increase the reliability of these devices Furthermore, the development of charge coupled devices (CCD) will also be undertaken The CCD LCLV provides an efficient and flexible means of data storage for cross correlation processing The feasibility of LCLV devices has been investigated by Hughes Aircraft Company under U S Air Force sponsorship Available LCLV first-generation devices are presented being investigated for data correlation processing applications at JSC This effort will be expanded in FY-84 to FY-86 to incorporate the newly developed LCLV devices for specific applications to the shuttle and space station data correlation processing

W83-70153 **506-54-21**
Ames Research Center, Moffett Field, Calif
FAR INFRARED DETECTORS AND COOLERS RESEARCH
C R McCreight 415-965-6549
(506-61-81 422-50-06)

The objective of this RTOP is to develop advanced infrared detection systems for astronomical research This program will provide the technology for new and more efficient data acquisition capability throughout the infrared (IR) spectrum (2 to 200 microns) for the low-background astronomical application It will benefit the entire NASA IR astronomy program including future programs such as the shuttle infrared telescope facility (SIRTF) and the large deployable reflector (LDR), and the on-going ground based airborne and balloon-borne programs The objectives of this RTOP are to develop a fundamental understanding of the behavior of cryogenic devices that are generic to the space applications of low noise high sensitivity receivers for communication and astronomical systems advance critical optics technology for future telescope systems and optical instrumentation, and, develop technology for the efficient storage of cryogens in space

W83-70154 **506-54-23**
Langley Research Center, Hampton Va
HIGH RESOLUTION LASER SENSING RESEARCH
J M Hoell 804-827-2818
(506-54-23)

The objective of this research is to investigate advanced laser and electro-optic sensor concepts, broadband passive microwave systems, develop systems technology and perform systems-level laboratory and field technology demonstration for remote and in situ sensing of atmosphere and marine properties Specific sensor areas to be investigated are passive laser heterodyne system technology for remote measurement of the atmospheric species, active laser (LIDAR) sensing system technology for remote high vertical resolution measurements of atmospheric species wind velocities (e g shear turbulence and transport determination) and pushbroom microwave radiometer technology for measurement of geophysical parameters using large space antenna systems

W83-70155 **506-54-25**
Jet Propulsion Laboratory Pasadena, Calif
ACTIVE AND PASSIVE SENSOR RESEARCH
N M Nerheim 213-354-2547
(506-54-15)

This RTOP provides research and development support for visible and ultraviolet lasers for remote sensing applications In the area of primarily visible lasers, the proposed work involves basic research to exploit a new discovery utilizing anti-Stokes Raman scattering to obtain tunable laser radiation, and improving the operating parameters of the copper halide laser for spaceborne altimetry applications In the area primarily ultraviolet lasers the thrust is toward field measurements The objectives of this program are to develop infrared detector arrays and to demonstrate IR array instrument systems applicable to future NASA remote sensing missions The objectives also include detailed parametric characterization of infrared detector capabilities The objective of this program is to develop evolutionary devices which will result in innovative camera systems Four areas of technology will be examined They are wide spectral band CCD sensors on-chip motion compensated CCD sensors ultra-low noise CCD sensors and on-chip spectral filters

W83-70156 **506-54-26**
Goddard Space Flight Center Greenbelt, Md
SENSOR RESEARCH AND TECHNOLOGY
J Bufton 301-344-5626
(676-59-36, 692-20-10 147-10-11)

Mechanical cooler and solid cryogenic technology will be provided which will be applicable to the large number of future missions that will require instrument cryogenic cooling The data base for the properties of instrument optical components at cryogenic temperatures will be expanded by developing the apparatus and making appropriate measurements to configure state-of-the-art hardware and software to provide an instrument system simulator with interactive and realtime capabilities for use by engineers and scientists in the design development, analysis and parametric study of instrument concepts In addition advanced technology and system concepts will be developed for active and passive microwave sensing of the Earth and its environment Lasers and laser-related components and instruments will also be developed in support of NASA programs in geophysics time transfer, and the atmospheric sciences To continue our development of millimeter and submillimeter-wave coherent detectors (mixers) with sensitivity approaching the ultimate quantum noise limit To demonstrate the feasibility of this approach a 115-GHz SIS receiver will be built for operation on the Columbia/GISS radio telescope SIS tunnel diodes will be provided to our specifications, by IBM Sperry, Princeton University, and the University of Virginia, under cooperative (no-cost) agreements To produce an array of high quantum efficiency high energy resolution X-ray detectors capable of imaging X-ray sources at energies above 1 Kev by utilizing deep diode technology The approach utilizes the 'deep diode method wherein aluminum (Al) electrodes or posts are thermally driven through a silicon base wafer

W83-70157 **506-54-27**
Lyndon B Johnson Space Center Houston, Tex
MULTIFUNCTION SAR TECHNOLOGY
K Krishen 713-483-5518

Synthetic aperture radar (SAR) systems provide day/night, nearly all weather high resolution data not available with sensors in the other parts of the electromagnetic spectrum Recent NASA Active Microwave Remote Sensing Research Program Plan indentifies several unique Earth resources applications of SAR's The potential of SAR's for these applications can only be established in a limited manner with the presently available SAR capabilities which include single-frequency, single-*polarization and swatch-widths up to 100 Km The objective of the* Multifunction SAR Technology Program is to develop technology for the fabrication of multimission spacecraft SAR s capable of operating at selectable frequency(ies), polarization(s) bandwidth incidence angle(s), and wide swath with improved spatial resolution and calibration The immediate goal is to conduct studies, design fabricate, and conduct performance tests for advanced antenna systems calibration subsystems, advanced distributed array SAR, and wide-swath SAR's to allow fabrication of SAR systems with new functional and performance capabilities for missions planned for the 1985 to 1995 period Demonstration of the new technology will be accomplished through laboratory, aircraft, or spacecraft testing on a subsystem level for the most efficient use of the resources Other technology areas which include pixel elevation mapping, frequency agile/diversity SAR, phase/polarization mapping, and bistatic SAR will also be identified and prioritized for future development

W83-70158 **506-54-50**
National Aeronautics and Space Administration Washington, D C
AEROSPACE COMPUTER SCIENCE UNIVERSITY RESEARCH
Ronald L Larsen 202-755-2364
(505-37-20)

The objectives are to develop university-based center for aerospace computing technology, focusing on concurrent processing, highly reliable computing, and scientific and engineering information manage-

ment and foster cooperative, coordinated research coupling computer science with aeronautics, astronautics, and space sciences

W83-70159 **506-54-56**
Goddard Space Flight Center, Greenbelt, Md
MPP - SYSTEMS SOFTWARE R & T
Kenneth Wallgren 301-244-5184
(506-54-36)

The objective of the MPP Software RTOP is to develop systems level software critical to the Massively Parallel Processor (MPP) This software will provide tools, techniques, and languages to allow applications programmers to efficiently develop, test, and demonstrate discipline specific software on the MPP The secondary objective is to provide operation and maintenance support for the MPP hardware system The approach consists of developing and maintaining software modules at the systems level These include critical MPP executive routines, compiler(s), libraries, and the MPP simulator

W83-70160 **506-54-61**
Ames Research Center, Moffett Field Calif
ADVANCED CONCEPTS FOR KNOWLEDGE-BASED EXPERT SYSTEMS
H Lum 415-965-6544
(506-54-31, 506-54-51, 506-31-01)

Development of basic computer science tools required for knowledge-based expert systems will provide the impetus for automated spacecraft, space platforms, scientific instruments and ground based stations Use of these tools in automated expert systems will result in more scientific return per unit dollar and minimum labor-intensive tasks This research effort will utilize the results developed for NASA at NBS (W Gevarter), the computer science expertise available at Stanford University, and the experience resident at prominent companies utilizing artificial intelligence techniques such as Digital Equipment Corporation, SRI and Fairchild The research emphasis will be in the areas of image understanding and information extraction, heuristic programming, and natural language systems Early feasibility demonstrations will be conducted as major significant milestones are accomplished, potential demonstrations will include applications in space flight mission operations centers, airborne and ground based infrared astronomical observatories, and technology transfer programs

W83-70161 **506-54-63**
Langley Research Center, Hampton, Va
AUTOMATION SYSTEMS RESEARCH
A J Meintel, Jr 804-827-2489
(506-57-23 506-64-23)

The objective of this activity is to develop and support the technology base required to design, develop, and automate teleoperator and robotic systems to enhance man's capabilities for future space activities including servicing, maintenance and reparing, structural assembly and space manufacturing To achieve these objectives, the program focus will be to conceptualize, investigate, and verify algorithms, sensors actuators, software and system architecture required for remote space operations The research will be conducted through simulation and laboratory hardware experimental tests Parametric studies and analysis will be conducted to identify subsystem and component requirements Control research will include control modes, stability, time delays, trajectory optimization, and evaluation of various levels of direct, shared manual/computer, and supervisory control Basic research on the application of adaptive control techniques for the control of flexible or limber manipulators with distributed sensing and actuation will also be supported The application of artificial intelligence techniques for autonomous task planning multiple system coordination, and monitoring and diagnosing the functioning of systems and subsystems will be evaluated

W83-70162 **506-54-65**
Jet Propulsion Laboratory, Pasadena, Calif
AUTOMATION TECHNOLOGY FOR PLANNING, TELEOPERATION AND ROBOTICS
S Grenander 213-354-2683
(506-57-25)

The general objectives are to develop the technology base required in automated planning and decision making in the space program and to provide automated manipulation, sensing and actuation technology for future NASA teleoperation and robotics applications, such as satellite servicing, space assembly, and space construction The objectives of the uplink process control automation effort are to identify, develop and guide development and demonstrate techniques and technologies which have the potential of allowing the uplink process for mission operations to be designed and operated with significantly reduced cost, significantly increased responsiveness and with a higher degree of accuracy than is possible with currently applied techniques and technologies The objective of the automated decision making/machine intelligence effort is to develop software tools that automate NASA mission operations functions which are now labor-intensive Functions being investigated are (1) automatic generation of computer code by planning methods and concomitant automated scheduling (applied to mission command sequence generation), (2) automated fault diagnosis of spacecraft (applied to monitoring of telemetered data) In addition, assistance in using these tools is provided to the workers engaged in the uplink and downlink process control tasks of mission operations The objective of the teleoperation and robotics task area is to provide technology in sensing, perception, and manipulation needed for future NASA missions utilizing teleoperators and robots Included are tasks in (1) interactive automation for teleoperators (2) sensor based control languages, and (3) machine vision

W83-70163 **506-54-66**
Goddard Space Flight Center, Greenbelt, Md
AUTOMATION RESEARCH AND TECHNOLOGY FOR NEAR-EARTH MISSION OPERATIONS
D Friedman 301-344-6242

The objectives are to help provide NASA with a full understanding of knowledge based systems technology and to provide via prototype applications, a demonstration of its potential in the area of command and control systems Applications of knowledge based techniques in command and control systems will be prototyped to demonstrate proof-of-concepts Another objective is to expand the application of automation in the space program The intention is to provide NASA with the basic technology required for knowledge based systems The approach of this RTOP is to perform basic research in machine intelligence (primarily at universities) and to perform evelopment on machine intelligence in a NASA context (primarily in-house) The final goal is to develop a technology which can provide automated on-ground or in-orbit assembly, disassembly, servicing, and repair of aerospace systems used in NASA missions This technology uses a knowledge base which contains the information describing the automatic tooling motions and tests required for performing such tasks on a specific system This data will be generated from the computer aided design process used to create the system The data would include items needed to generate the appropriate actions for assembly or disassembly such as component location orientation, shape, and attachment method

W83-70164 **506-54-67**
Lyndon B Johnson Space Center Houston, Tex
AUTOMATIONS TECHNOLOGY FOR MANNED SPACE SYSTEMS
Max Engert 713-483-2872

The objective of this RTOP is to develop automation technology as applied to manned space transportation and space station systems Focus of the activity will be on two major areas automatic fault detection and isolation and the automation of a labor intensive subsystem peculiar to manned systems In the latter area the environment control and life support system has been selected This system, when its present level of technology and complexity as extrapolated from existing manned transportation systems to those of the future and that required by the space station, will be entirely impractical unless it is automated A key component of the approach is the development and application of expert systems to the areas covered by this RTOP

Space Energy Conversion Research and Technology

W83-70165 **506-55-12**
Lewis Research Center, Cleveland, Ohio
ADVANCED CONCEPTS IN ENERGY CONVERSION
R W Bercaw 216-433-6992

The objective of this effort is to investigate advanced concepts in energy processing for space applications The energy processing elements include the areas of (1) sources, (2) conversion techniques and devices, (3) storage, and (4) transmission or distribution systems and components Concepts to be investigated in this program are those considered to be high risk and innovative but, if successfully developed, could provide substantial performance improvements for space missions beyond the 1990's New energetics concepts will be actively pursued through in-house activities, publicity, and contacts with the leading researchers in relevant fields While the emphasis will be shifted from contracted to in-house investigations, every effort will be made to locate funding for the investigation of promising new concepts when the originators wish to participate in their development or unique training (not available at LeRC) is required An overguidelines request is being submitted to fund

these efforts which include continuation of some of the investigations initiated in FY-82

W83-70166 **506-55-13**
Langley Research Center, Hampton, Va
ADVANCED RADIANT ENERGY CONVERSION
E J Conway 804-827-3781

Advanced radiant energy conversion research is in direct support of space power technology for the future and provides the basic efforts needed to achieve significant advances Through this research, promising concepts are systematically explored, and the critical technologies involved in determining fundamental feasibility are generated This work provides the underlying understanding required to advance our capability to explore and use space The program objectives are to assess advanced concepts for space energy generation, conversion, storage, and distribution, and to develop the key technologies required to determine their feasibility This includes investigating direct conversion of fission and solar energy into laser radiation, generating and investigating novel means to convert solar and laser radiation efficiently to electricity, or other useful forms of energy, and assessing the technology status and potential applicability of known and proposed advanced energetics concepts, and demonstrating feasibility of selected technologies This program is a combined experimental and theoretical efforts performed in-house and on grants and contracts The core of the program is in-house, and is composed of three efforts lasers, converters of laser energy to electricity, and new concepts The program will also investigate additional concepts such as a high-current switch and a droplet thermal radiator

W83-70167 **506-55-15**
Jet Propulsion Laboratory, Pasadena, Calif
TECHNOLOGY OF ADVANCED CONCEPTS
R M Jones 213-354-6674
(506-55-12, 506-55-13)

The objective of this RTOP is to identify, evaluate, and if justified, recommend for additional OAST funding, innovative advanced concepts in the areas of energy collection, conversion, transmission, and storage which show promise of enabling or significantly enhancing future space power systems The feasibility of new and existing concepts will be evaluated For the purposes of this RTOP, technical feasibility is defined to have three components (1) an understanding of the basic physics of the concept, (2) a demonstration of key performance parameters, and (3) an understanding of the system implications of the concept Once the technical feasibility of a concept has been established, a recommendation for separate funding outside of the RTOP will be made for concepts that promise substantial payoff

W83-70168 **506-55-22**
Lewis Research Center, Cleveland, Ohio
ELECTRIC PROPULSION TECHNOLOGY
Thomas H Cochran 216-433-6897
(506-55-32)

The overall objective of this program is to conduct research on, and develop technology for electric propulsion systems for future earth orbital and planetary missions Applications include auxiliary propulsion for dense geosynchronous spacecraft and large space systems and primary propulsion for orbit maneuvering, orbit transfer, and planetary probes The kinds of propulsion systems considered will include ion thrusters, electrothermal rockets, and electromagnetic devices The program consists of analytical and experimental efforts Mission studies will be conducted to establish the performance potential of specific propulsion concepts Research will be carried out to understand basic physical processes and to establish the feasibility of specific approaches Focused technology activities will be directed toward characterizing the performance, lifetime, and interfaces of critical system elements such as thrusters and power processors Work will be performed in-house, on contract, and with university grants

W83-70169 **506-55-25**
Jet Propulsion Laboratory, Pasadena Calif
ELECTRIC PROPULSION THRUSTER SUBSYSTEM R&T
E V Pawlik 213-354-3455

The long term objective of this RTOP is to perform fundamental research into the controlling physical processes involved in advanced electric propulsion concepts such as the magnetoplasmadynamic (MPD) accelerator The FY-83 objective is to complete the preliminary technology evaluation of the MPD thruster and then embark on technology development leading to an MPD laboratory system demonstration Specific thruster performance goals for this program include thruster exhaust velocities between 10 to 30 km/sec, thrust efficiencies of 50%, and system lifetime commensurate with projected applications including both near-earth and deep space applications This effort will, early in FY-83, establish the fundamental viability of the MPD thruster by demonstrating that the problems limiting performance and lifetime can be resolved Technology development of a laboratory thruster system will then be initiated with efforts on energy storage, thruster optimization, and propellant valve development The approach will be to (1) conduct thruster erosion studies (2) improve thruster efficiency by conducting research into extending the MPD thruster operating range, and (3) develop an electrolytic capacitor for use in an MPD thrust system and investigate methods for improving thruster efficiency, design and test a propellant valve for use with an MPD thrust system, and explore feasibility of self switched thruster

W83-70170 **506-55-42**
Lewis Research Center, Cleveland, Ohio
PHOTOVOLTAIC RESEARCH AND TECHNOLOGY
H W Brandhorst 216-433-4000

The objective of this RTOP is to improve conversion efficiency, reduce mass and cost and increase the operating life of solar cells and blankets Research and technology programs cover diverse areas Emphasis will be placed on understanding and reducing the radiation damage suffered by high efficiency silicon solar cells and exploration of means to heal this damage by low temperature annealing Development of gallium arsenide solar cells for space applications will continue with special attention devoted to ultra lightweight cells less than 10 microns thick and durable high efficiency cells designed for sunlight concentration levels of 100 times in miniature Cassegrainian concentrator structures Efforts to develop cascade cells made from III-V semiconductor materials and having the potential for 30% conversion efficiency will continue and be augmented by the development of elements of mechanically stacked cascade structure Concepts utilizing the wave nature of light will continue to be explored theoretically and experimentally A major program to develop reliable, low-earth-orbit durable welded solar cell interconnects will continue and be augmented to include array design

W83-70171 **506-55-43**
Langley Research Center, Hampton, Va
SOLAR CELL RESEARCH
E J Conway 804-827-3781

This program, through in-house, grant, and contract research, developed the first laboratory GaAs cell having AMO efficiency greater than 18 percent, developed the first elevated temperature (> 200 C) GaAs solar cell, and pioneered in studies of electron and proton radiation effects and of thermal annealing for GaAs The program now emphasizes generation of new cell concepts and photovoltaic techniques This basic research effort is broadly oriented toward developing the technology to improve conversion efficiency, reduce mass, reduce cost, and increase the operating life of solar cells for space Potential space applications include high power space manufacturing stations, near-Sun exploration, long-life space platforms, and GEO missions A key research emphasis involves exploration of new photovoltaic and energy conversion materials This program continues research on thin crystal p-n junctions for high power-to-weight ratio space solar cells The goal is to achieve a GaAs solar cell with a specific power of approximately 700 W/kg Liquid phase and chemical vapor deposition epitaxial growth techniques are employed to develop these improved cells The long-term stability of cells and contacts at 200 C is studied to support concentrator and continuous annealing modes of operation New contact materials are systematically studied

W83-70172 **506-55-45**
Jet Propulsion Laboratory, Pasadena, Calif
HIGH PERFORMANCE SOLAR ARRAY RESEARCH AND TECHNOLOGY
Walter A Hasbach 213-354-6132

The primary objective of this RTOP is to develop and demonstrate high performance solar array technology suitable for future NASA missions The technology is focused on providing 300 W/kg arrays for GEO applications, but can also provide arrays which are superior, with respect to specific power (W/kg) and power per unit area (W/sq m), to those now considered for low Earth orbital (LEO), high Earth orbital (HEO) and interplanetary mission applications As an intermediate objective (FY-84), a 150 W/kg array suitable for HEO and GEO missions will be demonstrated Processes will be demonstrated for assembling high efficiency, ultrathin (50 microns or less) silicon solar cells into space qualifiable blankets By combining such innovations as gridded back contact cells, transparent polymer polyimide coatings and welded ultrathin (< 25 microns) interconnects, blanket specific power approaching 500 W/kg will be achieved provided that solar cells > 15% AMO are available A low mass, high strength array structure (STACBEAM), expressly designed for high performance blankets will be fabricated and integrated with the blanket to provide an array which has the potential to achieve 300 W/kg BOL for a GEO space environment

W83-70173 **506-55-49**
Marshall Space Flight Center, Huntsville, Ala
MULTI-KW SOLAR ARRAYS
William L Crabtree 205-453-2110

The objective of this RTOP is to advance the state-of-the-art in multi-kW solar arrays for earth orbit. It is necessary for support of future NASA missions such as space station This RTOP will be a combination of in-house contracted efforts and will consist of the following tasks (1) low cost multi-100 kw Solar Array Preliminary Design and Technology Deficiency Identification and Development, (2) investigation of theoretical concepts for power generation, and (3) materials evaluations for Earth Orbital solar arrays

W83-70174 **506-55-52**
Lewis Research Center, Cleveland, Ohio
ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE
L H Thaller 216-433-5260

The objective of this program is to attain long-life, high-energy density, high-reliability and lower-cost electrochemical storage and conversion devices The emphasis is on devices that will be required for future space missions The current focus is on technology for space station applications This emphasis will be conducted within the framework of multi-year plans which take into account the needs of user groups and the efforts of other NASA centers as well as the Air Force The approved Nickel-Hydrogen Plan and the Fuel Cell Plan, now in the final stages of review, describe the task areas and major milestones for these coordinated efforts The work in nickel-hydrogen aims at firmly establishing the component technology of current cell designs as well as investigating advanced cell design concepts applicable for multi-kilowatt systems The ongoing technology efforts in alkaline hydrogen/oxygen fuel cells and water electrolysis will continue to emphasize combined fuel cell-water electrolyzers for large low earth-orbit energy storage applications Efforts will also be maintained toward the goal of providing advanced technology fuel cell components for improved orbiter-type hardware as well as for orbital transfer vehicle-type applications The in-house efforts relate to electrode, separator, and component technologies to support these two major parts of the multi-kWh storage effort Chemical compatibility and pore size engineering of cell components are key Synthetic battery cycling and system assessments continue to provide guidance to the program

W83-70175 **506-55-55**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED ELECTROCHEMICAL SYSTEMS
I Stein 213-354-6048

The overall objective of this RTOP is to achieve improved performance, energy density and lifetime of space batteries for applications in earth orbital and interplanetary missions Objectives for the advanced electrochemical storage cell concepts task are to complete the final report which describes the fundamental understanding of failure mechanisms in Ni-Cd cells, to determine feasibility of beryllium electrodes in a stable, high specific energy primary cell, and to determine the feasibility of the new polymeric electrodes in high power, high specific energy secondary cells Objectives for the primary lithium battery task are to identify hazardous reactions that take place during reversal, demonstrate utility of accelerated testing, and demonstrate quality of materials of construction The secondary lithium batteries task objectives are to identify and understand the dominant mode of performance degradation of Li-TiS2 cells on cycling, and to identify improved cell components The respective approaches to each of the tasks will be (1) perform laboratory tests on beryllium passivation behavior in high dielectric electrolytes, and determine the electrochemical properties of selected and doped polymers, and the effect of various electrolytes on polymeric electrode stability, (2) conduct chemical, electrochemical, and thermal investigations to identify the reactions, as well as demonstrate utility of accelerated testing, and (3) conduct chemical and electrochemical investigations of the degradation of cell components, with emphasis on the electrode/electrolyte interfaces The effects of modifications of the cell components on cell performance and component degradation will also be studied

W83-70176 **506-55-57**
Lyndon B Johnson Space Center, Houston, Tex
ORBITAL ENERGY STORAGE AND POWER SYSTEMS
Hoyt McBryar 713-483-2783

The objective of this research effort is to advance fuel cell and electrolysis cell technology to maturity and to demonstrate suitability to large orbital energy conversion and storage requirements of high power and long life A data base will be developed at the cell, small stack, and component level This will provide the basis for design of the larger developmental test articles An interim test will be conducted on breadboard-type hardware of about 4 kw in the integrated mode to verify concept feasibility This will also serve as a test bed to help define technology limitations and to evaluate interaction phenomena of dissimilar fuel cell/electrolysis cell concepts Engineering model hardware will be fabricated which incorporates all technology advances for field demonstration of technology readiness The results will provide a basis for selection of the regenerative fuel cell over other potential concepts for large orbital energy storage systems

W83-70177 **506-55-65**
Jet Propulsion Laboratory, Pasadena, Calif
THERMAL TO ELECTRIC ENERGY CONVERSION TECHNOLOGY
G Stapfer 213-354-3922

The overall objective is to develop thermal-to-electric direct energy conversion technology to provide space power for near Earth missions as well as the exploration of the solar system The RTOP is divided into three areas The objective of the first task is to demonstrate the feasibility of a prototype thermal-to-electric conversion system (SP-100) for solar-independent high power (100 kwe) applications The objective of the second task is to develop high efficiency thermoelectric conversion alloys capable of operating at elevated temperatures for long periods of time The objective of the third task is to demonstrate the feasibility of highly efficient thermoelectric energy conversion devices operating at lower temperatures for use with radioisotope heat source These tasks are to be accomplished by conducting studies and developing basic components required such as thermal insulation, radiator materials, and power regulation leading to technology verification consistent with reactor and heat pipe technology development High temperature alloy development will be accomplished by developing new thermoelectric materials of the boron-carbon and the rare-earth sulfide system The synthesis and property evaluation of these materials are fundamental prerequisites for successful thermoelectric alloy development The approach in the thermoelectric conversion technology task is to develop new thermoelectric compounds by synthesizing the chromium-lanthanum sulfur material system and evaluate its potential for converter applications

W83-70178 **506-55-70**
National Aeronautics and Space Administration Washington, D C
SPACE ENERGY CONVERSION SUPPORT
J H Ambrus 202-755-3273

The objective is to provide support to the headquarters operation of the OAST Space Energy Conversion Program This will include (1) space energy conversion research at universities (2) operation of the multi-agency supported Power Information Center of the Interagency Advanced Power Group, (3) critical technology development efforts in the space energy conversion that are to be performed by other agencies (such as DOE)

W83-70179 **506-55-72**
Lewis Research Center, Cleveland, Ohio
POWER SYSTEMS MANAGEMENT AND DISTRIBUTION
R C Finke 216-433-5232

The objective is to provide the technology base necessary to control the generation and distribution of energy in future space systems and to assure their environmental compatibility The proposed work will define and develop the generic technology to enable large multi-kilowatt power systems in space In-house and contractual studies will be conducted, as needed, to determine performance requirements, system constraints, and new technology needs for future space power systems Contract, grant, and in-house experimental and analytical programs will be conducted to explore the basic physics of conductors, semiconductors, dielectrics, and magnetic and thermal materials for power devices, develop an analytical model of their operating principles, and develop working prototypical devices, demonstrating them and characterizing performance in typical circuits as required In addition, this program will perform ground tests to simulate and determine the impact of the environments on spacecraft systems, develop models of the physical phenomena, and define space tests to verify ground test data

W83-70180 **506-55-75**
Jet Propulsion Laboratory, Pasadena, Calif
SPACECRAFT POWER SYSTEMS R & T
P A Robinson 213-354-3882

The general objective of this RTOP is to develop the technology for controlling space plasma interactions with high voltage spacecraft surfaces This activity is part of a joint AF/NASA comprehensive research and technology program This technology will be required to provide design information for large spacecraft and high power modules The design of a space station will require this technology base, both because of it's size and use of high power modules Specific objectives for FY-83 will include (1) develop statistical models of the low earth/low latitude cold plasma environment, (2) RF characterization of low voltage arcs Specifically, this effort will provide information on the low energy

plasma environment near the Earth, study charged particle effects on spacecraft and solar array surfaces, and identify methods to incorporate charge release devices which are under development by the Air Force Geophysics Laboratory (AFGL) The approach will be divided into two major tasks The environment modeling and arc characterization task will address specific objectives (1) and (2) by modeling the near earth plasma environment and characterizing the EMI signature of arcs induced by high energy electrons

W83-70181 **506-55-76**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED POWER SYSTEM TECHNOLOGY
L W Slifer 301-344-8841

The basic objective for this RTOP is to convert advanced power technology R&D accomplishments at the various NASA centers and at other agencies (DOD, DOE) to a state of readiness for future flight applications The approach includes the overall assessment of R&D status, the evaluation of technology advancements in terms of potential for flight application, the completion of engineering development necessary to bring high potential advancements to technology readiness, and the analysis of power systems incorporating the advanced technology The RTOP consists of six tasks (1) power technology assessment (2) analytical modeling of power systems (3) assessment of nickel-hydrogen cell technology, (4) development of spacecraft power system utilizing inertial (flywheel) energy storage (5) forecasting of high voltage insulation performance, and (6) development of high density thermal transport devices

W83-70182 **506-55-77**
Lyndon B Johnson Space Center, Houston, Tex
THERMAL MANAGEMENT FOR ON-ORBIT ENERGY SYSTEMS
J G Rankin 713-483-4941

The objective of this RTOP effort is to (1) develop the technology necessary for thermal management of a large space station, (2) extend orbital lifetime capability of thermal management systems from months to several years, (2) provide the technology necessary for high energy density heat collection and transport, and (4) reduce the cost of very large scale heat rejection systems by orders of magnitude This will be achieved by establishing the technology for the design, fabrication, and test of hardware comprising a representative portion of a full scale system Such a system might consist of a pump assisted heat pipe providing a constant temperature 'thermal bus' or energy transport loop that would deliver or receive heat to/from the various subsystems and payload heat sinks or sources via one or more types of modular (i e, easily connectable/removable) thermal interface devices (contact heat exchangers, fluid or heat pipe quick disconnects, etc) The primary heat sink for such a system could be made up of relatively simple independent radiator elements contaning large high-capacity dual-passage heat pipes that would provide a space constructable radiator system with long life due to low system vulnerability to the micrometeoroid environment

W83-70183 **506-55-79**
Marshall Space Flight Center, Huntsville, Ala
MULTI-100 KW LOW COST EARTH ORBITAL SYSTEMS
J R Graves 205-453-2514
(506-55-62, 506-64-19)

The objectives of this RTOP are to provide the technology required to process, distribute, and control electrical power in multi-100 kW type platform systems and to reduce space energy costs through automation and improved efficiency, life, reliability, and maintainability These objectives will be accomplished via a combination of in-house and contracted efforts and will consist of the following tasks (1) develop power processing, conditioning, and distribution techniques for high voltage, multi-100 kW power systems, (2) develop automation techniques and utility-type power management and control for large space power systems, (3) construct a DC and an AC system breadboard for evaluation and demonstration of new technologies and power management techniques These tasks will be coordinated with space platform studies conducted under RTOP 506-64-019

Multidisciplinary Research

W83-70184 **506-56-20**
National Aeronautics and Space Administration, Washington, D C
MULTIDISCIPLINARY RESEARCH
J H Ambrus 202-755-3273

The objective is to conduct basic research in selected areas of a broad range of scientific and engineering disciplines in order to underpin advanced space technology The major emphasis will be to conduct fundamental investigations in focused areas of enabling technology for advanced space missions The approach is to grant multiyear funding to universities in order to build centers of excellence and to train scientists in fields of particular interest to NASA A specifically selected area is high temperature thermoelectric materials (Stanford) Also emphasized will research to utilize space as a unique scientific laboratory and conduct basic research experiments that would advance scientific understanding of basic principles not obtainable in earth bound laboratories This idea has been started and carried out for a number of years under the title of Physics and Chemistry Experiments in Space (PACE) The plans are to involve a broad scientific community and solicit new ideas

Controls and Human Factors

W83-70185 **506-57-13**
Langley Research Center, Hampton, Va
SPACECRAFT CONTROLS AND GUIDANCE
Lawrence W Taylor, Jr 804-827-4591

The objectives are to develop devices and advanced techniques for the analysis and synthesis of control systems for large space systems, particularly for pointing, active damping, and figure control Advanced techniques will be formulated, applied to specific spacecraft designs, and tested using ground and flight experiments Advanced techniques pertain to distributed parameter system modeling and control reduced order modeling theory, systems identification and parameter estimation, computer aided design, fault tolerant control synthesis, adaptive control, and shape control

W83-70186 **506-57-15**
Jet Propulsion Laboratory, Pasadena Calif
ADVANCED CONTROL TECHNOLOGY
A F Tolivar 213-354-6215

The long range objectives of this RTOP are to identify and develop fundamental control system design, analysis, components, and testing techniques required for the control of advanced spacecraft (including Earth-orbiting large antennas, space stations, and platforms) and for the control of space transportation vehicles This RTOP encompasses the following eight major tasks (1) control system synthesis - develop and evaluate control system designs for large antennas, for the large deployable reflector, and for space stations, (2) distributed control - develop fundamental control analysis and design technology for spacecraft systems which must be described by distributed parameter dynamical models, (3) applied systems identification - develop algorithms, software, and system concepts for off-line and real time characterization of spacecraft statics (figure) and dynamics (frequencies, modeshapes), (4) adaptive control - develop and demonstrate autonomous model error estimation and adaptive control techniques needed to compensate for the inevitable model and parameter uncertainties, (5) control technology validation - conduct ground demonstration of specific concepts in the laboratory and the definition of a control flight experiment including mission goals and objectives, preliminary system design and trades (6) advanced guidance and control components - develop a long life laser gyro and an optical sensor for determination of the static shape and vibrational motion of flexible spacecraft (7) advanced STS control - develop advanced STS control system concepts for expanded STS control envelope needed for on-orbit control of modular and flexible bodies, and (8) basic research grants - to sponsor university research in advanced concepts involving identification theory in random fields and distributed systems with long term application to modeling and control of flexible systems

W83-70187 **506-57-17**
Lyndon B Johnson Space Center Houston, Tex
STS CONTROL AND GUIDANCE TECHNOLOGY DEVELOPMENT
K J Cox 713-483-4281

The objective is to develop and assess guidance and control (G and C) concepts and techniques to provided needed capabilities for the full utilization of current and future space transportation systems (STS) Methodologies for the cost effective development and implementation of advanced G and C capabilities will also be evaluated Implementation approaches which result in highly reliable G and C capabilities will be investigated Four major tasks are included (1) methodology for STS control envelope definition/expansion, (2) software development interactive with system development, (3) expendable replenishment for on-orbit servicing, and (4) space vehicle control and guidance technology development support The approach is to address the G and C technology needs across interacting elements of STSs (e g, space shuttle, orbit transfer vehicles, teleoperators) Studies will be directed toward technology development which have the broadest application to these elements

and which integrate the requirements and constraints associated with the interactions of these elements Emphasis will be placed on the development of G and C technologies supporting STS on-orbit operations and services

W83-70188 **506-57-19**
Marshall Space Flight Center, Huntsville, Ala
LARGE SPACE SYSTEMS TECHNOLOGY CONTROL AND GUIDANCE
H J Buchanan 205-453-4582

The objective of this research will be to define, develop, and demonstrate control techniques and devices required for future space platforms, stations, advanced earth orbiting spacecraft, and advanced space transportation systems Tasks covered include (1) large space system control technique development and verification (2) modular control techniques, (3) autonomous momentum management for space stations as well as (4) control and sensing for autonomous rendezvous and docking (5) over-uprated find guidance sensor Outputs from these studies and development activities will provide technical data necessary for meaningful system trades and will generally support preliminary system definition work in the guidance and control area

W83-70189 **506-57-21**
Ames Research Center, Moffett Field, Calif
SPACE HUMAN FACTORS
H P Klein 415-965-5094
(505-35-21, 505-35-01)

Future manned space systems may place the operators in a position of having more autonomy and relying less on ground control These missions will involve highly trained astronauts as well as other flight crew members and scientists Maximum benefit from these future space systems will accrue where the abilities of the humans are fully exploited and their performance maximized with their errors reduced to a minimum The objective of this RTOP is to develop an understanding of the causes of human error which appropriately addresses the unique aspects of both individual and team operation in space The program will initially focus on gaining the maximum benefit of past experience with space operations in addition to operations in other stressful environments which have similar characteristics to those encountered in space Particular emphasis will be placed on bringing together current knowledge regarding operational problems Using this knowledge the first step in developing reliability model(s) for human operators in these future space systems will be initiated

W83-70190 **506-57-23**
Langley Research Center, Hampton, Va
MANNED CONTROL OF REMOTE OPERATIONS
A J Meintel, Jr 804-827-2489
(506-54-63, 506-64-23)

The objective of this plan is to study and develop through experimentation and analysis, the required controls and displays for efficient man-machine interface for control of remote systems and to apply advanced technology to enhance man's capability to accomplish remote operations by increasing his supervisory capabilities for complex automated systems The research will be conducted using a reconfigurable remote control station coupled to a software simulation/laboratory hardware representing the remote system Experimental studies will be conducted to determine human capabilities/limitations in teleoperation The remote control station will be reconfigured to evaluate the controls, displays, crew interactions, and systems interface requirements to provide enhanced sensory feedback for control and supervision of remote systems

W83-70191 **506-57-25**
Jet Propulsion Laboratory Pasadena, Calif
TELEOPERATOR HUMAN INTERFACE TECHNOLOGY
A K Bejczy 213-354-4568
(506-54-65, 906-75-27)

The general objective of this RTOP is to develop a data base and models for quantifying human performance in sensor- and computer-augmented information and control environment of space teleoperator systems in order to advance the state-of-the-art currently represented by the Shuttle RMS baseline technology This objective includes the classification measurement and evaluation of human performance parameters related to (1) kinesthetic-proprioceptive man-machine coupling, (2) analog and symbolic man-machine communication, (3) perceptive/cognitive processes involved in online decision making as a function of alternative presentations of a given control task the FY-83 objectives are (1) publish a study on critical human performance parameters in space teleoperation (2) define, design, and develop laboratory experiments for evaluating human performance in kinesthetic-proprioceptive man-machine coupling, integrated task-referenced displays, and interactive manual and computer control of remote manipulators, and (3) develop preliminary specifications for a space shuttle experiment for evaluating human kinesthetic performance in remote manipulator control under zero-g conditions The general approach is experimental It creates, maintains, upgrades and utilizes experimental capabilities at the JPL teleoperator laboratory to generate the necessary data Function allocations between man and machine will be studied for various operational constraints, including time delays New system and subsystem concepts will be developed and breadboarded when necessary Cooperation with other NASA centers and universities will be established as appropriate

W83-70192 **506-57-27**
Lyndon B Johnson Space Center, Houston, Tex
HUMAN FACTORS FOR CREW INTERFACES IN SPACE
J L Lewis 713-483-2845

The objective of this RTOP is to develop technologies which will increase the effectiveness of man-machine interactions in space Specific tasks include development of guidelines for displays and controls that will decrease operator workload and training requirements and will require less space and weight development of a portable terminal for a space station, and development of aids for performing extravehicular activities (EVA) Technologies to aid in the design of equipment and in operations planning will also be advanced This includes development of models of human strength and motion in zero-g, and development of a laser-based three-dimensional mapping system which will provide descriptions of human bodies and human motion for a designer's data base The approach will be to survey the current state-of-the-art to determine operational requirements, to build prototypes or models and collect data in one-g and zero-g conditions, and to generate design guidelines and designer aids on the basis of these tests Existing facilities that will be utilized include an avionics test bed, the Operator Station Design System computer-aided design (CAD) system and data base, and the Anthropometric Measurement Laboratory data base and equipment for collecting and presenting reach, force, and motion data These resources will be extended by addition of the mapping system and the strength and motion models Additonal data bases for tracking display and control technologies and results of prototype evaluations will be built

W83-70193 **506-57-29**
Marshall Space Flight Center, Huntsville, Ala
TELEOPERATOR AND EVA HUMAN FACTORS
F W Wagnon 205-453-4623

The objective of this RTOP is to (1) investigate and determine the role and the required degree of involvement of humans in space missions, (2) define and implement selected technology tasks relative to human factor requirements/benefits in the effective operation and utilization of teleoperators, and (3) define and evaluate human factor technologies required for crew station design, tools and crew aids as well as develop required guidelines and standards for effective and efficient man-in-the-loop space operations These efforts will be accomplished through a combination of both in-house and out-of-house efforts An in-depth survey study will be performed to, assess the present and ongoing developments in the area of human factors technology This survey will enhance the data base and provide a datum or point of departure for the other task defined in this RTOP

Space Data and Communications Research and Technology

W83-70194 **506-58-10**
National Aeronautics and Space Administration, Washington, D C
ARCHIVAL MASS MEMORY
Charles F Fuechsel 202-755-2364
(506-61-09)

The objective is to develop an on-line archival mass memory device capable of storing and retrieving up to 10 to the 13th power bits of information at rates up to 50M bits/second Laser-optical disk technology will be employed in concert with a mechanical manipulator to retrieve and mount individual disks

W83-70195 **506-58-11**
Ames Research Center, Moffett Field, Calif
FUTURE DATA SYSTEMS CONCEPTS
T L Grant 415-965-6526

The objective of this RTOP is to advance the state-of-the-art in data network technology through analysis of general concepts and the implementation of software simulation to define, develop, and evaluate detailed concepts, including promising coding designs The emphasis in this technology development is on reduced system complexity for data

networks and on increased reliability while providing the flexibility to expand data capacity as processing requirements increase A network simulation capability is planned via software models using the Ames Research Center computational facilities It will provide a test bed for developing and evaluating detailed conceptual designs as well as augmenting the analysis of general network concepts After the system requirements and evaluation criteria are defined, various data networks will be modeled in coordination with other Centers The software simulations will also be used to evaluate coding designs which will be developed for added capacity and error-free data distribution

W83-70196 **506-58-13**
Langley Research Center, Hampton, Va
DATA SYSTEMS RESEARCH AND TECHNOLOGY
N D Murray 804-827-3535

The primary objective of the Data Systems Research and Technology activity is to investigate research, and develop key technologies for (1) real-time, very high-speed data and information processing onboard spacecraft, (2) high density, high speed data storage for onboard spacecraft, and (3) network architectures and optical buses to attain high performance processing, communications, and distribution of information onboard a space station To address the onboard real-time information processing, the information adaptive system (IAS) is being developed to process multispectral images, and the IAS will be extended to include processing of spatial image data for space station, processing algorithms unique to space requirements are being developed, and VLSI/VHSIC integrated circuits are being investigated and designed for space applications The main thrust of the onboard data storage activity is the development and demonstration of highly reliable, advanced magnetic bubble memory devices and system prototypes This activity is composed of two elements ion implanted, magnetic bubble memory development and current-accessed self-structured bubble memory development The network and optical bus activity is oriented to the development and demonstration of optical components, wavelength division multiplexing subsystems, and network architecture systems, which are directed toward meeting space station requirements

W83-70197 **506-58-15**
Jet Propulsion Laboratory, Pasadena, Calif
DATA SYSTEMS RESEARCH AND TECHNOLOGY
T C Duxbury 213-354-4889
(506-54-05, 506-54-06, 506-54-15)

The objectives of this RTOP are to develop and demonstrate the systems technology and techniques which enable more efficient and effective transfer of useful data from the sensor to the user, and facilitate sensor control by a distributed body of users at substantially reduced cost and complexity with emphasis directed toward the requirements of manned space station missions such as fault tolerance and subsystem autonomy The approach to meeting these objectives includes in basic research spacecraft and space station technologies Basic research will extend the theoretical basis for modeling and translating data structures between heterogeneous data bases and will advance optical transmission and processing technology Spacecraft efforts will develop very high speed processing of on-board synthetic aperture radar imaging by ground-based facilities Additionally space station efforts will concentrate on developing advanced data system architectures which are readily adaptable in flight to changing mission requirements and which provide automatic detection and recovery from component failure in flight This architecture will provide relative insensitivity to evolving device technologies and localize the effects of changes within subsystems to reduce the costs and complexities of system-level integration testing and verification

W83-70198 **506-58-16**
Goddard Space Flight Center, Greenbelt, Md
DATA SYSTEMS RESEARCH AND TECHNOLOGY
R W Nelson 301-344-7809

The program objective is to develop and demonstrate the systems technology and techniques which can enable more efficient and effective transfer of useful data from the sensor to the user, extraction of information by the user, and exchange of information between users The approach will be to conduct a continuing systems analysis to guide and evaluate the program, to develop new subsystems and operations concepts, and to implement and test demonstrate prototype elements of the end-to-end system

W83-70199 **506-58-19**
Marshall Space Flight Center, Huntsville, Ala
ON-LINE DATA INGEST/STAGING SYSTEM
D T Thomas 205-453-3577

The objectives are to (1) develop technology to enable very rapid processing of large volumes of space sensor data by ground-base facilities, (2) reduce the cost of processing and storing information by several orders of magnitude, while increasing the lifetime of storage media, and (3) evaluate the feasibility of adapting and applying this high density storage technology to flight systems

W83-70200 **506-58-22**
Lewis Research Center, Cleveland, Ohio
SATELLITE COMMUNICATIONS RESEARCH AND TECHNOLOGY
R E Alexovich 216-433-6689
(650-60-21 506-54-12, 650-60-20, 650-60-22)

The objective is to provide through research, design, and experimental tests the components, subsystems and enabling technology required to support NASA satellite communications systems To achieve this objective, advanced research and development programs will be conducted to identify, produce, and demonstrate critical components, techniques and subsystems required for complete communications systems Principal emphasis will be directed toward spacecraft microwave electron beam amplifiers with increased power output, efficiency high frequency capability and long life, multi-frequency, multibeam antennas providing increased frequency reuse, and solid state materials and component technology for high frequency spacecraft applications, such as switching, power amplification and beam forming

W83-70201 **506-58-23**
Langley Research Center, Hampton, Va
MULTIPLE BEAM ANTENNA TECHNOLOGY DEVELOPMENT PROGRAM FOR LARGE APERTURE DEPLOYABLE REFLECTORS
Thomas G Campbell 804-827-3631
(506-62-43)

The overall objective of this RTOP is to specifically address the development of multiple beam antenna technology and analysis methods that are critically related to the technology development activities of the deployable reflector concepts presently funded by Code RS or OAST The development of multiple beam feed technology that is specifically related to the large aperture antenna development will eventually provide NASA the capability of predicting the total antenna system performance characteristics for a wide range of mission applications (communication, radiometer, and radio astronomy) Primarily, this activity shall provide a top-level basis for determining the effectiveness of large off-set reflector systems (with up to 200 beams) that are presently being considered for communications and radiometer near-term and far-term missions Tasks to be accomplished include the development of the feed requirements for communication and radiometer (PBMR,) missions for multiple beams and multiple apertures, antenna configuration design for the point design, multiple beam antenna feed point design, and derivation of secondary illumination and multiple beam contour for co-polar and cross-polar plots, spherical near-field testing using subscale models

W83-70202 **506-58-25**
Jet Propulsion Laboratory, Pasadena, Calif
DEEP SPACE AND ADVANCED COMSAT COMMUNICATIONS TECHNOLOGY
J F Boreham 213-354-4107

This RTOP represents the consolidation of two prior RTOPs namely Deep Space Communications Technology (DSCT) (formerly called High Speed Data Transfer X/S Band Components) and Advanced Communications Satellite (ACS) Technology Research and Development (formerly called Earth Satellite Communication Antenna Development) The general objectives of this RTOP are to develop microwave communications system component technology to support space-to-earth data distribution/transfer requirements of NASA's future deep space missions and ACS type missions The objectives in the DSCT area center on the development of solid state microwave power amplifiers as replacement for the expensive and relatively unreliable TWTA's, while in the ACS area they center around large multibeam antenna technology development More specifically, during the first quarter of FY-83 a 10/22 watt X-band solid state power amplifier (XSSPA) using high efficiency (> 35%) 1 and 2 GaAs FETs will be evaluated and demonstrated and by the end of FY-83 development of key components of a 20/40 watt XSSPA using high efficiency 4W GaAs FETs will be completed In FY-84 the 20/40 watt XSSPA will be evaluated and demonstrated and development of a high power array feed power amplifier based on prior technology developments of this RTOP will be initiated In the ACS area, more specific objectives for FY-83 and FY-84 include (1) complete the development of design concepts for contiguous multiple beam antennas/feeds (2) continue the updating of software necessary for designing and predicting performance of advanced antenna systems, and (3) initiate the development of ground and in-flight RF measurement techniques for large spaceborne antennas

W83-70203 **506-58-26**
Goddard Space Flight Center, Greenbelt, Md
COMMUNICATIONS: TDRSS FOLLOW-ON/INTERSATELLITE LINKS
J S Chitwood 301-344-6375
(506-54-42)

The program objective is to advance microwave technology in data transfer techniques to satisfy the communications requirements of future space flight programs Microwave and millimeter wave spacecraft components, techniques, and circuits will be developed to support flight programs characterized by high data rates, simultaneous multiple links, and reliable long life operation High data rate solid state transmitters, low noise receivers, and millimeter wave antenna systems will be developed

W83-70204 **506-58-27**
Lyndon B Johnson Space Center Houston, Tex
SPACE STATION COMMUNICATION TECHNOLOGY
Max Engert 713-483-2872

The objective is to bring communications technology, which is primarily in support of hardware implementations on a permanently manned space station, to a proper state of technology readiness Expected accomplishments include (1) reduction of the communications system life cycle cost including cost of impacts due to incremental growth, (2) significant reduction in space station operational compromises, and (3) reduction of programmatic risk for unique space station communication requirements Technical target areas include intra-vehicular communications, RF equipment (transmitters, receivers, antennas), and ranging/tracking systems Extensive breadboard developments will be evaluated in the JSC Electronic Systems Test Laboratory providing total end-to-end system performance evaluation including the effects of relay satellites, ground stations, and other space vehicles

Chemical Propulsion Research and Technology

W83-70205 **506-60-10**
National Aeronautics and Space Administration, Washington, D C
CHEMICAL PROPULSION R&T INTERAGENCY SUPPORT
F Stephenson 202-755-2490

The primary objective of this activity is to maintain a continuous up-to-date information gathering capability on the nation's total chemical propulsion technology efforts as an aid in planning and implementing the NASA program In addition, joint interagency tasks are undertaken when appropriate, such as publishing handbooks, manuals, or computer models, that will be beneficial to the propulsion community as well as other potential users The approach is to share support of the Chemical Propulsion Information Agency (CPIA), which supplies information gathering and dissemination services, with the DOD agencies through the Joint Army, Navy, NASA, Air Force (JANNAF) Interagency Propulsion Committee For special interagency tasks, funding is transferred to the agency designated as responsible for the procurement action and contract monitoring

W83-70206 **506-60-12**
Lewis Research Center, Cleveland, Ohio
EARTH-TO-ORBIT PROPULSION LIFE AND PERFORMANCE TECHNOLOGY
D A Petrash 216-433-6860
(506-52-19)

The driver for future Earth-to-orbit launch vehicles will be advanced high pressure liquid rocket engines used for the main propulsion system These propulsion systems will have to provide the lowest possible life cycle costs while meeting the needs of all potential users The objective of this program is to extend the existing technological base established by the space shuttle main engine and older hydrocarbon fueled engines to provide the knowledge for reusable, long life, serviceable, high performance engine systems using either hydrogen-oxygen or hydrocarbon-oxygen This effort will concentrate on thrust chamber cooling and life enhancement, critical turbomachinery components including bearings, seals, turbine blades, rotordynamics diagnostic techniques, and improved materials This work will be accomplished through studies, analytical models, fundamental subscale testing, and correlation of all inputs

W83-70207 **506-60-17**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED MANNED VEHICLE ONBOARD PROPULSION TECHNOLOGY
R W Polifka 713-483-5557

The objective of this effort is to identify viable propulsion system designs and propellant alternatives which could replace N2O4/MMH in a second generation shuttle auxiliary propulsion system or similar advanced spacecraft propulsion systems, and to establish the technology base necessary to allow for future systems development Phase out of N2O4/MMH become necessary due to handling health hazards, high propellant cost, and high corrosivity of these propellants The oxygen-hydrocarbon propellant family provides the most attractive alternative Oxygen-hydrocarbon type propellants will be characterized and system design and trade studies conducted Propellant and design selections will be made and critical component technology and technology issues will be identified Component technology will be developed and carried forward into assembly level test evaluation

W83-70208 **506-60-19**
Marshall Space Flight Center, Huntsville, Ala
REUSABLE HIGH PRESSURE MAIN ENGINE TECHNOLOGY
S F Morea 205-453-3908
(506-52-12)

Advanced reusable booster engines required for Earth-to-orbit application are being investigated The overall objectives are to (1) advance the technology base for future oxygen/hydrocarbon booster engines and (2) advance the technology in support of future space shuttle main engine (SSME) improvements More specifically, technology for advanced high pressure oxygen/hydrocarbon rocket engines for booster application is being pursued and includes single-fuel, dual-fuel and dual-throat concepts These activities include engine power cycle synthesis, parametric data generation, component performance prediction and evaluation, and combustor and turbine cooling investigations These efforts include data screening, analysis, computer modeling, hardware design and fabrication, data evaluation, and test As the SSME program approaches operational status, specific technology activities are required for resolution of persistent trouble areas and for improving life and reducing operating cost The effort necessary to accomplish these objectives is defined in the Advanced Research and Technology Plan, rev June 1, 1982 The areas of investigation are basic in nature and are supportive of future SSME uprating and definition of advanced lox/hydrocarbon engines

W83-70209 **506-60-25**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED LOW THRUST CHEMICAL PROPULSION TECHNOLOGY
M W Dowdy 213-354-2182
(506-64-25)

The general objective of this RTOP is to provide technology for advanced on-board spacecraft chemical propulsion systems which will find application on Earth-orbiting space stations and satellites as well as planetary spacecraft Specific objectives relevant to the FY-83 efforts are (1) assess technology readiness of propulsion system options for space station, (2) evaluate development potential of ultra high performance propulsion concepts, (3) formulate technoloy development plan for low thrust (30-100 lb(f)) gaseous O2/H2 propulsion system for a space station, (4) develop validated plume contamination model, and (5) provide propellant/material compatibility data base for advanced propulsion systems A technology assessment of propulsion system options for a space station will be conducted and most promising options and critical technologies identified Contractor studies and a proof-of-concept experiment will be used to identify best advanced propulsion concepts Following a system requirements definition phase, a contractor effort will formulate a preliminary gaseous O2/H2 thruster design for a space station and identify critical technologies An electric motor-pump will be tested and a technology development plan established A molecular beam experiment will be conducted to measure sticking coefficients for use in plume contamination models The on-going long-term propellant/material compatibility task for Earth storable propellants will be expanded to include the new formable material, Ti-15-3(3), and tests will be initiated in the new cryogenic materials compability facility

W83-70210 **506-60-42**
Lewis Research Center, Cleveland, Ohio
VARIABLE THRUST OTV PROPULSION TECHNOLOGY
D A Petrash 216-433-6860
(506-60-49)

The objective is to provide technology for improving performance, life, and reusability of future highly versatile liquid chemical rocket engines in order to greatly extend mission capability and flexibility in performing orbital operations reliably and at reduced operating costs The propulsion

systems that will be investigated include a highly versatile, throttleable, reusable, and maintainable high thrust rocket engine and a high performance low thrust expendable rocket engine Emphasis of the work will be on combustion, cooling, and heat transfer, performance enhancements, long life bearings and seals, lightweight reusable components, small high performance combustors and pumps, high expansion area nozzles, and propellant management

W83-70211 **506-60-49**
Marshall Space Flight Center, Huntsville, Ala
OTV PROPULSION PERFORMANCE AND PLUME CHARACTERIZATION
R J Richmond 205-453-3710
(506-52-42)

Advanced reusable oxygen/hydrogen engines required for future orbit-to-orbit vehicles are being investigated The activities include advanced engine power cycle analysis and synthesis, technology identification and acquisition, component and system performance prediction model improvement and concept demonstration of a novel, jet engine driven, high altitude simulation test facility These efforts include computer modeling, data screening, analysis, hardware fabrication, test, and data evaluation Both low and high altitude plume flow field computer programs are being developed employing new technology in flow field methodology where applicable These programs will not be restricted to hydrogen/oxygen but will be applicable to all currently envisioned propellant systems In addition to the flow field programs, a state-of-the-art high altitude plume impingement analysis will be developed Support will also continue for the JANNAF sponsored Plume Technology Handbook

Spacecraft Systems Research and Technology

W83-70212 **506-62-21**
Ames Research Center, Moffett Field, Calif
STUDY OF LARGE DEPLOYABLE REFLECTOR FOR INFRARED AND SUBMILLIMETER ASTRONOMY
M K Kiya 415-965-6548
(506-61-31 506-61-41 358-41-06)

The objective of this RTOP is to assess and develop technologies for the large deployable reflector (LDR) Critical technologies have been identified in the feasibility and system concept definition study and at the 1982 Science and Technology Workshop Also, continuing systems feasibility studies will define LDR technology requirements and the implication of the status of the technology on the LDR system concept Several technologies identified and requiring development are segmented mirrors, figure and pointing control, thermal control, support structures, and deployment technique The approach is to continue the technology assessment in the most critical areas and initiate development activities for mirror segments in FY-81 and for optical (alignment and figure) controls in FY-83 The end objective of this RTOP is to integrate the various LDR technologies into a demonstration proof of concept

W83-70213 **506-62-23**
Langley Research Center, Hampton, Va
ADVANCED LARGE SPACECRAFT SYSTEMS ANALYSIS
L S Keafer 804-827-3666
(506-62-43, 506-64-13)

The long-range technical objective is to support development of advanced spacecraft systems for NASA science applications, DOD missions, and commercial ventures in space The work includes mission, system and experiment concepts definition, technology analysis and needs assessment, and building of a versatile computer aided design and analysis capability for advanced spacecraft systems Priority tasks for FY-83 involve (1) defining space flight experimental approaches for validation broadly applicable technologies, (2) further definition of Earth observation spacecraft, in particular a conceptual design of a hoop-column antenna spacecraft for microwave radiometry, (3) kinetic/kinematics analysis of deployment of various antenna configurations, and (4) controls-dynamics interaction study and development of first-order controls synthesization and analysis techniques Primarily in-house mission, system and discipline expertise and analysis tools will be used to accomplish the definition and analysis tasks Contractual work will complement the in-house effort in controls-dynamics studies, system evaluations, and detailed designs and analyses The computer aided design capability will be augmented primarily by in-house development and software exchanges with industry

W83-70214 **506-62-25**
Jet Propulsion Laboratory, Pasadena, Calif
PLANETARY AEROCAPTURE SYSTEMS RESEARCH AND TECHNOLOGY DEVELOPMENT
M I Cruz 213-354-5709

The objective of this RTOP is to bring to an orderly conclusion the planetary aerocapture systems research and technology development activity The conclusion of planetary aerocapture will be in the form of a final report This will document in a concise fashion all research and technology, and conceptual design efforts performed in the development of the generic planetary aerocapture systems

W83-70215 **506-62-49**
Marshall Space Flight Center, Huntsville, Ala
SOLAR ARRAY FLIGHT EXPERIMENT (SAFE) DYNAMICS & CONTROL AUGMENTATION (FLIGHTS 1 AND 2)
Henry C Hill 205-453-3423
(542-03-04)

The major objectives of phase 1 (flight 1) are to develop and demonstrate the technology readiness of on-orbit remote sensing and data processing systems for subsequent use in large space structure dynamic response measurements, to process the data obtained from the remote sensing tests, and to define dynamic characteristics of solar arrays for correlation with theory, ground test data, and response control techniques applicable to large, flexible space systems

Transportation Systems Research and Technology

W83-70216 **506-63-23**
Langley Research Center, Hampton, Va
TECHNOLOGY REQUIREMENTS FOR ADVANCED SPACE TRANSPORTATION SYSTEMS
J P Arrington 804-827-3911

The objective of this RTOP is to identify, justify, and prioritize high leverage enabling and enhancing technologies for both current evolutionary and future new space transportation systems This includes the projection of future transportation needs, the characterization of potential future mission and economic capabilities based on the design of advanced concepts, and the assessment of technology impact on desired transportation attributes The approach focuses on the total transportation system, including both Earth-to-orbit and orbital transfer vehicles, which operate primarily within the geosynchronous sphere The intent is to build on the space shuttle technologies which enhance the current Space Transportation System (STS) and enable new systems which have significant cost and/or capability advantages when they will be required as a second generation STS Technology areas of particular interest include composite and thermal protection materials, propulsion systems, structural design, aerothermodynamics, design integration, advanced flight control, and automated operations This activity will be pursued through in-house system studies, selected in-house assessments, contracted system assessments, and intercenter reviews

W83-70217 **506-63-27**
Lyndon B Johnson Space Center, Houston, Tex
AUTOMATION OF SPACE TRANSPORTATION SYSTEMS
Max Engert 713-483-2872

The objective is to assess automations concepts and techniques applicable to advanced transportation systems Concepts which provide ways of reducing the cost or enabling the performance of the high mission rates of the Shuttle Program (circa 1985 and beyond) will also be investigated Selected areas are those involved in such mission operations as premission planning and flight execution support including anomaly analysis and response in near real time A key task is the automation of the data base system which supports the flight operations The approach is to direct automations related tasks at key space transportation areas involving labor intensive human involvement where advances in technology can make significant reductions in cost through increased overall system efficiency

W83-70218 **506-63-29**
Marshall Space Flight Center Huntsville, Ala
CONCEPTUAL CHARACTERIZATION AND TECHNOLOGY ASSESSMENT
R E Austin 205-453-2769
(906-63-04)

Aeroassist is a technological capability that has a potential ranging from significant mission enhancement (orbit transfer vehicle-OTV) to mission enabling (some planetary orbiters and DOD) Prior studies have

shown that significant performance benefits can be realized by using an aerodynamically assisted insertion into an orbit (planetary and low Earth) This maneuver substantially reduces the mission propellant requirements by using the aeroassisted maneuver to significantly reduce a propulsive maneuver Studies have assessed aeroassisted system concepts ranging from simple devices to high L/D winged systems While aeroassisted concepts show performance advantages over all propulsive concepts, launch capabilities, basin techniques (ground or space), and mission requirements (OTV DOD, planetary, etc) have a strong influence on aeroassisted system concept selection It is the objective of this RTOP to conduct a multi-year aeroassisted system technology activity that will evaluate generic aeroassisted OTV system concepts leading to a selection of the most promising approach for initial aeroassisted OTV application This activity then leads to a focused OTV technology readiness program (phase 1) for the initial system that has a target completion in FY-87 A follow-on aeroassisted technology development activity (phase 2) is envisioned that would permit an upgrading to a manned OTV capability Transportation systems technology will be evaluated to focus and analyze technology requirements for advanced transportation systems, Earth launch vehicles, orbit-to-orbit vehicles, etc The initial phase of the transportation systems technology assessment will extend over a multi-year period

W83-70219 **506-63-31**
Lyndon B Johnson Space Center, Houston, Tex
OEX (ORBITER EXPERIMENTS) PROJECT SUPPORT
J D Harris 713-483-5814

The OEX Program was initiated jointly by JSC and OAST to utilize the space shuttle as a research vehicle The program objective is to collect data in the technology disciplines that will augment the research and technology base for future spacecraft design Flight data relative to these disciplines will be collected by utilizing the currently planned TFI/MADS configuration, by modifications and/or augmentations to the orbital flight test baseline instrumentation and by development of unique experiments compatible with the operational capabilities for flight on the orbiter Studies will be conducted to determine the optimum method of utilizing the shuttle system to conduct research and technology These studies will be augmented by investigations to develop experimental programs that would obtain research and technology data in flight regimes applicable to advanced space transportation systems Th primary goal of these studies is more efficient utilization of the STS capabilities to obtain data required to advance the current state of spacecraft technology This RTOP includes the effort associated with overall project management, project support, experiment development initiation, experiment compatibility assessments, experiment integration activities and integration hardware development initiation The experiment development effort is the subject of additional RTOP's from the appropriate NASA centers

W83-70220 **506-63-32**
Langley Research Center, Hampton, Va
SHUTTLE ENTRY AIR DATA SYSTEM (SEADS)
P M Siemers 804-827-3984
(506-51-13)

The objective is to extend the knowledge of aerodynamic, aerothermodynamics and basic fluid mechanics into flow regimes previously inaccessible to the investigator through extraction of flight data during routine operation of the shuttle orbiter This knowledge will be applied to verify and increase the reliability of sophisticated computational prediction codes, to develop procedures to extrapolate wind tunnel data to flight conditions, to improve the performance and operational capability of the STS, and to provide a data base for studies of future aeronautical and aerospace vehicles The design, development calibration, and demonstration of the flush orifice Shuttle Entry Air Data System will be accomplished and through-inhouse (LaRC) analysis and test programs, and contracted studies A retrofitted instrumented nose cap, incorporating the flush orifice Shuttle Entry Air Data System, will obtain flight data which, when reduced, will produce the required air data parameters for each orbiter flight These data, in conjunction with inertial data, development flight instrumentation data, and data obtained by specialized instrumentation packages, will be utilized to verify aerodynamics and aerothermodynamics performance as well as resolve many basic fluid mechanic questions

W83-70221 **506-63-34**
Langley Research Center, Hampton, Va
SHUTTLE INFRARED LEESIDE TEMPERATURE SENSING (SILTS)
E V Zoby 804-827-2707

The objective is to extend the knowledge of the basic aerothermodynamics of leeside flow fields and heat transfer on large lifting vehicles into flow regimes which are inaccessible to investigations in ground facilities through sensing of leeside surface temperatures during shuttle orbiter entry with an infrared scanner These data will permit development of improved leeside flow field and heat transfer prediction techniques which are required to reduce considerably the weight and cost of thermal protection systems on the leeside of future space vehicles This experiment utilizes a highly developed infrared scanner and recording system which will be qualified for the severe ascent environment in a development program at the Langley Research Center The instrumentation and supporting equipment will be installed in a Langley manufactured engineering test model and tested at the Langley Research Center the flight structural pod, exclusive of the dome, will be manufactured by the shuttle orbiter contractor, and the experiment will be installed in Orbiter 102 at KSC The SILTS experiment will be flown on a number of early orbiter flights

W83-70222 **506-63-35**
Ames Research Center, Moffett Field, Calif
INFRARED IMAGERY OF SHUTTLE
H Lum 415-965-6544
(506-51-31)

The purpose of this RTOP is to design, develop, and conduct an experiment to be used in conjunction with the first orbital flights of shuttle The experiment is part of the Orbiter Experiments program (OEX) and will obtain measurements of surface temperature of the lower and side surfaces of the orbiter by means of remote high resolution infrared imagery This imagery is obtained on board the C-141 Kuiper Airborne Observatory The experimental equipment to be developed consists of an acquisition telescope and appropriate servo system, a cryogenically cooled focal plane and detector array, and a data handling and storage system In addition, the software required to produce an engineering image from the raw experiment data will be developed under this RTOP

W83-70223 **506-63-36**
Ames Research Center, Moffett Field, Calif
OEX THERMAL PROTECTION EXPERIMENTS
H K Larson 415-965-5369
(506-53-31 506-51-41)

The overall objective of these experiments is to obtain a better understanding of thermal protection system (TPS) reentry heating effects that may permit TPS cost and weight reductions for shuttle and advanced space transportation systems Four separate experiments will be flown as test panels or tiles replacing baseline TPS on the shuttle orbiter during orbiter flight tests and operational fights These experiments will take advantage of the real entry heating environment that cannot be fully simulated in ground facilities to demonstrate advanced TPS materials for possible orbiter retrofit and to investigate TPS heating effects Temperature data will be obtained with existing and follow-on orbiter instrumentation Baseline TPS procedures and tooling will be used, and none of the experiments will impact orbiter operations The experiments will be designed and fabricated by both in-house and contract efforts, and experimental hardware will be provided as Government furnished equipment

W83-70224 **506-63-37**
Langley Research Center, Hampton, Va
SHUTTLE UPPER ATMOSPHERE MASS SPECTROMETER (SUMS)
R C Blanchard 804-827-3984
(506-51-13)

The primary technological objective is to provide flight data for advances in the prediction of aerodynamic behavior throughout the high-speed flight regime, including the free molecular flow and the transition into hypersonic continuum This objective will be achieved through shuttle orbiter flight instrumentation, including a shuttle upper atmosphere mass spectrometer (SUMS) The specific objective of the SUMS system is to provide in situ high altitude atmospheric data, primarily neutral atmospheric mass density measurements A spare Viking flight-qualified mass spectrometer will be modified to provide atmospheric data in the rarefied flow flight regime These data, coupled with data from other proposed experiment systems, will provide aerodynamic information on a winged entry vehicle in flight regimes heretofore unobtainable and will augment ground-based test facilities In addition, experiment results on the shuttle will provide a benchmark from which to evaluate additional entry technology research The design, construction, and system tests of the prototype shuttle upper atmosphere mass spectrometer (SUMS) and the supporting analysis on the SUMS system design and implementation will bring the experiment to the flight readiness state

W83-70225 **506-63-39**
Goddard Space Flight Center, Greenbelt, Md
DYNAMIC, ACOUSTIC AND THERMAL ENVIRONMENTS (DATE) EXPERIMENT (TRANSPORTATION TECHNOLOGY VERIFICATION--OEX PROGRAM)
William F Bangs 301-344-7669
(506-63-39, 506-53-66, 323-52-42)

The DATE experiment is one of the OAST OEX (orbiter experiments) group of STS flight experiments The DATE program has two objectives The first is the development and validation of advanced technology for prediction of dynamic, acoustic, and thermal environments and associated payload responses in cargo areas of large reusable space vehicles The second is providing data for immediate application in payload design *and verification activities The DATE program plans to use environmental* data from 7 to 12 early shuttle flights in support of these technology efforts The early shuttle flights represent an unusual opportunity to obtain the particular types and quantities of data that are suitable for implementing the DATE program, but would not be included in the environmental data normally acquired for operational purposes By end of FY-82 DATE will have accomplished its partial objectives with experimental data produced from flights STS-1, STS-2, STS-3, and STS-4 In FY-83, the objectives will be to continue integration support of delivered calibrated instrumentation, data analysis, and data distribution for flights of opportunity on STS-5, 6, 7, 8, and 9 Funding resources and programmatic considerations will determine the number of flights (but planning is based on three for FY-83) This program is planned to be a joint funded effort between OAST, USAF, and Office of the Chief Engineer

W83-70226 **506-63-40**
Ames Research Center, Moffett Field, Calif
SPACE SHUTTLE ORBITER FLYING QUALITIES CRITERIA (OEX)
D T Berry 805-258-3311

Experience with high-performance aircraft was used extensively to *establish handling qualities and flight control system criteria, specifications,* and design guides for the atmospheric flight phases of the space shuttle atmospheric flight phases of the Space Shuttle With the opportunity of test data from the forthcoming orbiter flight test, the adequacy of the existing criteria can be evaluated to provide a sound basis for improvements of the orbiters and to establish validated criteria to support the development of second generation orbiters Pilot comments and ratings will be obtained for essential tasks throughout the reentry and landing phases of the orbiter flight tests Studies will be initiated to develop suitable criteria, in the event that the present criteria are found to be inadequate Pilot ratings and comments will be correlated with vehicle characteristics obtained from analysis of stability and control maneuvers obtained during shuttle flight tests

W83-70227 **506-63-42**
Lyndon B Johnson Space Center, Houston, Tex
OEX-ADVANCED AUTOPILOT
Edward T Kubiak 713-483-3878
(506-63-31)

The objective of the orbiter experiment advanced autopilot experiment is to verify in flight a new and unique autopilot which employs a multi-dimensional phase space rotational and translational control law as an impovement over conventional autopilots which use two dimensional phase plane rotation-only control laws The advanced autopilot will also employ an optimizing linear jet select algorithm The new autopilot is principally software which is to be programmed into a shuttle flight computer for the experiment There its performance can be compared with that of the existing shuttle autopilot

W83-70228 **506-63-43**
Langley Research Center, Hampton, Va
HIGH RESOLUTION ACCELEROMETER PACKAGE (HIRAP) EXPERIMENT DEVELOPMENT
R C Blanchard 804-827-3984

The primary objective is to provide accurate measurements of low level aerodynamic acceleration along the shuttle orbiter roll, pitch, and yaw axes in the rarefied flow flight regime This flight data supports advances in the prediction of aerodynamic behavior of winged entry vehicles in the high-speed, low density flight regime, including the free molecular flow and the transition into the hypersonic continuum An orthogonal triaxial set of linear accelerometers will be mounted on the existing orbiter experiment (OEX) aerodynamic coefficient instrumentation package (ACIP)/PCM mounting shelf Hardware development and integration aspects are accomplished by NASA-JSC, OEX Project Office under a modification to current ACIP-1 development Studies under this RTOP will be performed to support the design, development, and calibrations of the high resolution accelerometer package (HiRAP) to achieve experiment objectives In Addition, data reduction algorithms will be designed, developed, tested, and applied on mulitple flights of the HiRAP

Platform Systems Research and Technology

W83-70229 **506-64-12**
Lewis Research Center, Cleveland, Ohio
SPACE STATION PROPULSION REQUIREMENTS
M E Valgora 216-433-5186
(506-60-42, 506-55-22)

The objective of this effort is to define and develop system level technology requirements for chemical and electrical propulsion systems and power for electrical propulsion applicable to space platform systems These studies will develop a technology and cost data base to assist in guiding decisions on which propulsion technologies have the highest potential These studies will determine performance requirements, identify system constraints, estimate cost, weight, and size of potential propulsion systems, identify new technology needs, determine benefit/cost ratios, and identify priorities of proposed technology programs

W83-70230 **506-64-13**
Langley Research Center, Hampton, Va
TECHNOLOGY SYSTEMS ANALYSIS ACROSS DISCIPLINES FOR PERMANENTLY ORBITING SPACE STATIONS
L J DeRyder 804-827-3666

The objective of the RTOP is to develop system optimization trades across subsystems to determine the maximum technology improvement for permanently orbiting space station systems System analyses and interdiscipline interaction sensitivity studies will be performed to define technology drivers and priorities for high leverage discipline technology programs Multidisciplinary systems analysis/optimization methodology and techniques will be developed which provide for modular evolutionary on-orbit growth with advanced technology to satisfy national needs for improved performance while minimizing life cycle costs System/subsystem interface architecture requirements will be investigated to both enable and optimize the evolutionary expansion of functional on-orbit system capability An analytical capability for performing life cycle/technology cost benefit assessments will be developed

W83-70231 **506-64-15**
Jet Propulsion Laboratory, Pasadena, Calif
SPACECRAFT SYSTEM TECHNOLOGY
D M Turner 213-354-2436
(506-62-69)

Spacecraft maintenance consists of routine operations and fault protection required to achieve a fully functioning, calibrated spacecraft ready to execute a mission The objective of this investigation is to conduct analyses, define requirements and develop system concepts leading to autonomous spacecraft maintenance where an important consideration for these new autonomous features is that which reduces the cost of mission operations while maintaining high performance and reliability Autonomy will be accomplished by development of spacecraft design concepts which utilize a high degree of onboard capability to perform operations These concepts will allow maintenance of these operations in the presence of faults and reduce dependence on ground supervision An automated spacecraft will (1) improve man's productivity in space by minimizing his involvement in repetitive tasks, (2) handle complex concurrent operations, (3) perform operations where the response time required is less than the two-way light time, (4) reduce life cycle costs, and (5) allow operations to be performed while out of Earth contact This RTOP also supports the specific objective of determining the requirements for an agency-wide Contamination Data Base Specifically, this effort will determine both the user community (within the agency, DOD, and industry) and their needs for such a data base The approach to be taken in this effort will be to consult both the contamination community and the already established Contamination Working Groups established with the NASA and DOD Also, support to the NASA/AF Interdependency Working Group will be included

W83-70232 **506-64-19**
Marshall Space Flight Center, Huntsville, Ala
PLATFORM SYSTEMS STUDY
R E Jewell 205-453-0436

Described herein is a platform systems analysis effort which consists of two tasks The first task is a systems analysis effort with the objectives of defining the technology required to enhance the capability, reduce the development, and lower the cost of manned and unmanned platforms Specifically, the effort is to consist of special emphasis trade analyses which are identified as offering high potential for revealing platform improvements but recognized as too complex and interactive to be

conducted in a survey systems technology analysis addressing a broad range of platforms, subsystems, and payloads The approach for defining the platform technology is to first identify the maximum benefit areas through conducting the special emphasis trade analyses, and then to identify the technology which must be achieved in these areas to realize the benefits The second task has the objective of defining and evaluating the automation technology and techniques for a power subsystem to reduce life cycle costs, extend the operational life, and improve system performance The approach is to use a systems level evaluation for accomplishing these objectives The third task is a study analysis to assess the use of expert systems to control and manage multifunction/configuration spacecraft in a real time environment Task three is submitted as an overguideline requirement

W83-70233 **506-64-22**
Lewis Research Center, Cleveland, Ohio
PLATFORM SYSTEMS, OPERATIONS
G R Smolak 216-433-6631

The broad objective of the Cryogenic Fluid Management Program is to provide the research and technology base required to design efficient systems for the management of cyrogenic fluids in the space environment The approach to the Cryogenic Fluid Management Program is broad based ranging from fundamental research to applied technology, and includes both analysis and experimentation Required experimentation is both ground- and space-based The program features inter-center involvement with LeRC, MSFC, JSC, and GSFC, there are two program thrusts, applied system and component technology, and fluid management fundamental research Development of the Cryogenic Fluid Management Facility (CFMF) as a shuttle payload is a required part of the applied system and component technology Additional in-space testing will be required to achieve the fluid management fundamental objectives Fundamental experiments involving two-phase heat and mass transfer will be defined and the hardware developed suitable for conduct within the STS Low gravity experiments in the areas of reorientation, and pool and flow boiling will be designed and fabricated via combined contracted/in-house efforts The data acquired in space will provide basic understanding of low gravity phenomena and will be utilized to develop advanced technology for propulsion stages, life support, and environmental control systems

W83-70234 **506-64-23**
Langley Research Center, Hampton, Va
TELEOPERATOR AND ROBOTICS SYSTEM ANALYSIS
A J Meintrl, Jr 804-827-2489
(506-54-63, 506-57-23)

The objective of this effort is to develop an integrated systems simulation analysis tool for evaluation of teleoperator and robotic systems capable of remote space operations, and evaluate at the systems level, subsystem and components and identify high leverage areas requiring research to allow development of a telepresence system which outperforms direct human manipulation An integrated robotic software simulation has been under development This simulation will be expanded and coupled to a manned control station to allow system level integration and analysis studies of remotely controlled vehicles capable of space operations The near-term approach will be to implement in the Teleoperator and Robotic Systems Simulation (TRSS) software models representing the Remote Orbital Servicing System (ROSS) concept TRSS will allow systems integration and evaluation of emerging concepts in robotics The output of the simulation will supply specifications for the design, development, and testing of remote systems

W83-70235 **506-64-25**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED THERMAL CONTROL TECHNOLOGY FOR CROYOGENIC PROPELLANT STORAGE
P W Garrison 213-354-3225
(506-60-25)

The objective of this RTOP is to provide the technology for long life, low mass active cooling systems for cryogenic propellant thermal control application Joule Thomson (JT) refrigerators driven by adsorption or absorption compressors can potentially meet these requirements The Approach consists of assessments to identify attractive compressor designs and optimum operating parameters and experiments to characterize candidate absorber materials and to evaluate compressor/refrigerator performance

W83-70236 **506-64-26**
Goddard Space Flight Center, Greenbelt, Md
IN-SPACE FLUID MANAGEMENT TECHNOLOGY - GODDARD SUPPORT
Allan Sherman 301-344-5405
(506-64-26)

This RTOP provides manpower to support the In-Space Fluid Management Program managed by the Lewis Research Center Details of the program are in the Lewis RTOP The Cryogenics, Propulsion and Fluid Systems Branch will provide technical consultation on the supply tank of the Cryogenic Fluid Management Facility, review facility specifications and design concepts, check analyses, and make suggestions The justification for the program is in the primary RTOP The involvement of Goddard has been approved in a Memorandum of Agreement signed by the Lewis Research Center and the GSFC directors As part of the technical consultation on the supply tank system of the Cryogenic Fluid Management Facility, all facility specifications and design concepts will be informally reviewed, analyses will be checked, and the final design will be reviewed Suggestions for modifications or design improvements shall be transmitted in a timely manner to the principal technologist

W83-70237 **506-64-27**
Lyndon B Johnson Space Center, Houston, Tex
SPACE STATION OPERATIONS
W K Creasy 713-483-2561

The objective of this RTOP effort is to (1) establish system design requirements and operating procedures for docking/berthing maneuvers required for construction, assembly, and satellite servicing tasks, (2) identify component technology needs and systems design drivers through analysis of the projected program requirements, including requirements for minimum disturbance 'soft' docking/berthing, and (3) demonstrate validity of system and component design and operational concepts through full-scale ground tests of development hardware This will be achieved by developing requirements, performing conceptual design studies, performing parametric trade studies, and developing prototype hardware for proof-of-concept systems ground tests One additional objective in the area of cryogenic fluid management is to identify and evaluate attractive technical concepts for a liquid hydrogen quantity gauge for zero-gravity use in support of the Lewis Research Center's Cryogenic Fluid Management Facility

W83-70238 **506-64-29**
Marshall Space Flight Center, Huntsville, Ala
TELEOPERATIONS AND CRYOGENIC FLUID MANAGEMENT
F W Wagnon 205-453-4623
(906-63-13)

This RTOP includes two areas of activity teleoperations and cryogenic fluid management In the area of teleoperations, a survey will be done on existing developments in teleoperators a potential teleoperator mission will be characterized and defined, a comprehensive set of requirements will be developed and assessed for this early mission and an assessment will be performed on the Space Telescope extravehicular activity support functions to determine how these could best be accomplished by a teleoperator controlled from a ground station In the area of cryogenic fluid management, an anaytical/experimental assessment of the thermodynamic, fluid mechanic, and heat transfer interactions between components and subsystems within a liquid hydrogen management system for orbital propulsion will be performed A large scale test article will be used in conducting the experimental tests Results will provide design guidance for OTVS, supporting orbital experiments and normal gravity data for comparison with low gravity results Technologies involved in the development of reusable cryogenic insulations will be pursued

W83-70239 **506-64-31**
Ames Research Center, Moffett Field, Calif
SPACE STATION LIFE SUPPORT TECHNOLOGY
P D 415-965-5733 Quattrone
(199-60-12, 199-60-22)

The objective of this program is to develop space station crew/life support air revitalization, waste management, and thermal control technology to support the establishment of permanent human presence in space This program objective includes technology development to support the initial space station and for later space station subsystem retrofits This program is designed to implement the Space Station Steering Committee's Crew and Life Support Working Group recommendations in task 5, task 6 and task 12 The objectives of these tasks are as follows (task 5) to provide extravehicular maneuvering unit (EMU), manned maneuvering unit (MMU), and extravehicular activity (EVA) support equipment technology to quarantee that construction, maintenance and repair of an initially launched space station can be accomplished with safety and facility, (task 6) to secure regenerative life support system technology for a 1990 space station launch, and (task 12) to achieve a technology-ready condition for regenerative life support that provides improved process efficiencies, increased system closure, and additional personal accommodations in contrast to the technology utilized in the initial space station The specific subsystem technologies in this RTOP include passive thermal control, electrochemcal

CO2 concentration, hyperfiltration wash water recovery, static feed water electrolysis O2 generation, and supercritical waste oxidation

W83-70240 **506-64-37**
Lyndon B Johnson Space Center, Houston, Tex
LIFE SUPPORT SYSTEMS TECHNOLOGY DEVELOPMENT
A F Behrend 713-483-4823

This RTOP is in direct support of the space station development program and reflects the recommendations made by the Crew and Life Support Working Group to the OAST Space Station Technology Steering Committee The objectives are to secure a mature regenerative life support technology base for a 1990 space station launch and to provide backup technology readiness in regenerative life support These objectives are to be directed at the following life support functions atmospheric revitalization, atmospheric control, and water reclamation

Space Systems Technology Programs

Spacecraft Systems Technology

W83-70241 **542-03-01**
Jet Propulsion Laboratory, Pasadena, Calif
DEVELOPMENT OF A SHUTTLE FLIGHT EXPERIMENT. DROP DYNAMICS MODULE
T G Wang 213-354-6331

The principal objective of this RTOP is to design, fabricate, and test an acoustic positioning and manipulation module for Spacelab and to utilize it to perform the experiment Dynamics of Rotating and Oscillating Drops as part of the NASA Physics and Chemistry in Space Program on an early shuttle spacelab mission, and will be available for Spacelab flights thereafter This acoustic positioning and manipulation module will allow one to utilize the unique zero-g environment provided by a shuttle/Spacelab flight to perform drop dynamics experiments that are impossible to perform in a gravitational field Examples are (1) study experimentally the problems first proposed by Newton, and never satisfactorily studied, of equilibrium figures and the bifurcation processes of a rotating spheroid, and (2) understand the fission and fusion processes in drops that are also applicable to meteorology The scope of this work is threefold first, to determine the maximum capability of this facility within the constraints of money and schedule through consultation with the scientific community and investigators, second, to fabricate a flight unit, and third, to perform the perform the experiment Dynamics of Rotating and Oscillating Drops as part of the NASA Physics and Chemistry in Space Program The scientific community will be invited to participate in experiments informally through international symposia and colloquia Some scientists will participate with JPL as science associates and consultants

W83-70242 **542-03-04**
Marshall Space Flight Center, Huntsville, Ala
SHUTTLE OPERATIONAL FLIGHT TEST OF A LARGE SOLAR ARRAY
Henry C Hill 205-453-3423
(506-34-19, 506-62-49)

The objective of this RTOP is to provide overall demonstration of the availability of advanced solar array technology by flight testing the Solar Array Flight Experiment as an experiment on shuttle Demonstrating that the array will deploy and retract in space environment and establishing its dynamic characteristics are objective which are particulary important The approach consists of four basic steps (1) define, through study and analysis, the requirements, criteria, and conceptual design for the solar array experiment system, (2) Perform a detailed design, build, and test the flight array experiment, (3) install and fly the solar array experiment on shuttle, and (4) Evaluate flight results after return to Earth

W83-70243 **542-03-14**
Langley Research Center, Hampton, Va
FILE FLIGHT EXPERIMENTS--ANALYSIS AND SUPPORT
W E Sivertson 804-827-3666
(506-18-23, 750-02-23, 506-61-73)

The objective of this RTOP effort is to support future identification and location experiment (FILE) flight experiments and the advancement of feature classification and cloud detection technology Data processing techniques will be developed, evaluated, and used to process and analyze advanced feature classification and cloud detection flight data and imagery Experimental FILE instrumentation parameters will be assessed relative to in situ flight performance Also, principal investigator participation in FILE I/OSTA-3 and FILE II/LearJet flight operations and data collection will be included The FILE flight data will be analyzed to evaluate image scene classification relative to vegetation, bare earth, water, clouds, snow, and ice Classification will be based on selected radiance ratios from spectral signature data in the 0 65, 0 85, 1 23, and 1 55 micron bands Results from this effort will focus on providing new knowledge required for developed autonomous cloud detection, pointing, and tracking instruments for future missions In-house FILE image processing techniques will be developed Existing LaRC computer and color image display systems will be used to analyze data and generate color-enhanced images Classification algorithms will be developed and in-house statistical evaluations will be conducted to assess performance

W83-70244 **542-03-20**
Jet Propulsion Laboratory, Pasadena, Calif
SPACE CALIBRATION OF SOLAR CELLS
L Sidwell 213-354-5489
(506-55-45)

The objective of this RTOP is to take advantage of the space enviorment of the STS missions to correlate solar cell calibration data with those obtained from a balloon flight The STS program will provide the opportunity to validate existing calibration procedures and to determine the most cost effective way of accomplishing solar cell calibrations During FY-83, support will be provided to close out any action items resulting from the final design and operation review with MSFC Candidate test solar cells will be selected and installed on th solar cell calibration facility Level 4 integration will be supported at KSC Preintegration and flight readiness reviews will be supported and any action items resulting from these and/or other reviews will be closed out prior to launch (scheduled for April FY-84)

W83-70245 **542-03-27**
Marshall Space Flight Center, Huntsville, Ala
TRIBOLOGICAL EXPERIMENTS IN ZERO GRAVITY
R L Gause 205-453-1500

The experiment, 'Tribological Studies of Fluid Lubricated Journal Bearings in Zero Gravity,' will compare in a zero gravity enviroment the hydrodynamic films formed in journal bearings by conventional smooth bore bearings versus a 3-lobed bearing design In addition, the effect of centrifugal loading on these lubrication systems will be investigated The experiment entitled, 'Wetting, Spreading and Operating Characteristics of Bearing Lubricants in a Zero Gravity Environment,' will measure the spreading rates of lubricants in a zero gravity environment and determine the extent to which lubricant wettability is affected by this environment In order to study the tribology of journal bearings in zero gravity, transparent journal bearings will be fabricated for both conventional and experimental designs Plans call for photography of these bearings operating in zero gravity The behavioral characteristics of lubricants will be determined by photography of selected-surface combinations and telementered dynamic behavior of the journals

W83-70246 **542-03-30**
Langley Research Center, Hampton, Va
CRYSTAL GROWTH IN SPACE
R K Crouch 804-827-3535
(179-80-70)

Objectives of this program are to design and fabricate the necessary hardware and experiment to fly onboard the shuttle in the materials processing in space program and to continue development for scheduled follow-on flights These experiments, supported by the ground-based studies, will be utilized to provide data on important parameters needed to improve state-of-the-art Earth based growth of compound semiconductor crystals

W83-70247 **542-04-13**
Langley Research Center, Hampton, Va
LOW DURATION EXPOSURE FACILITY
Leo P Daspit, Jr 804-827-3704

The broad LDEF project objectives are the following (1) to develop the Long Duration Exposure Facility (LDEF), (2) to develop and perform a first set of experiments on the LDEF, and (3) to broaden the operational STS user community The LDEF, a shuttle transported, reusable, unmanned, low cost free flying structure on which many different experiments can be mounted, will be developed and manufactured in-house at Langley The experiments, many of which are completely passive with active data measurements being made in the laboratory after recovery, will be solicited from all NASA ceners, other government agencies, industry, and foreign countries The STS user community will be broadened by the LDEF providing a unique, simple, low cost approach to perform large numbers of needed long duration technology

and science experiments The establishment of a continuing program to provide for LDEF reflights after the first LDEF mission with the operational STS is a part of this RTOP The implementation of the established follow-on program is not

W83-70248 **542-05-12**
Lewis Research Center, Cleveland, Ohio
FLIGHT TEST OF AN ION AUXILIARY PROPULSION SYSTEM (IAPS)
James F DePauw 216-433-6119

A major of the OAST-LeRC electric propulsion effort is to achieve technology readiness and user acceptance of a high performance, long life mercury ion auxiliary propulsion system for use in the 1980's Accomplishment of this goal depends on attaining the following objectives conduct a flight test of a mercury ion auxiliary propulsion system, provide engineering information on the system performance and system intefaces with the spacecraft, and involve potential users in program activities The approach is to conduct a space flight test on an ion auxiliary propulsion system oprated for time duration and duty cycle representative of potential operational missions The flight system uses two 8-cm diameter mercury ion thrusters operating at one millipound thrust level The experiment will be flown aboard AF Space Test Project spacecraft The program also includes a ground test program to provide data on system performance and interfaces and a principal investigator function to technically guide the program and interact with potential users

OFFICE OF SPACE SCIENCE AND APPLICATIONS

Environmental Observation Applied Research and Data Analysis

W83-70249 **146-10-04**
Ames Research Center, Moffett Field, Calif
CLIMATE MODELING WITH EMPHASIS ON AEROSOLS
J B Pollack 415-965-5530

A coordinated set of theoretical, laboratory, and field investigations of the chemistry and radiative properties of natural (e g , volcanic) and man made atmospheric aerosol particles are conducted in order to assess their impact on regional and global climate The field investigtions are intended to provide complementary information on aerosols to that being obtained from spacecraft platforms (e g , SAM II and SAGE) so as to insure that a comprehensive set of aerosol properties are gathered for climate analyses The theoretical and laboratory tasks are directed at interpreting and utilizing the aerosol data sets to perform the desired climate assessments The centerpiece of the field investigations is a set of coordinated aerosol measurements, which are flown together on an appropriate aircraft platform (e g , U-2) When possible, these flights are conducted in conjunction with spacecraft and other airborne aerosol measurements Information is obtained on both the aerosol formation mechanisms and on their radiative properties so as to enable the development of a predictive capability as well as a determination of the present climatic effect of aerosols Both theoretical modeling and laboratory studies are used to further define the mechanisms of aerosol formation, to provide hypotheses that can be tested by the field investigations, and to provide ultimately the predictive tools Theoretical investigations involving radiative transfer, dynamics, and aerosol formation are utilized for making the climatic assessments

W83-70250 **146-20-10**
Ames Research Center, Moffett Field, Calif
TROPOSPHERIC AIR QUALITY - TECHNOLOGY DEVELOPMENT
Boris Ragent 415-965-5404
(146-10-04, 147-10-03)

The broad research objective is to characterize tropospheric chemistry with a view toward determining impacts on the many aspects of environmental quality relevant to human health, agriculture, climate, and weather Present emphasis of this RTOP is to develop the needed airborne instrumentation systems capable of measuring the important tropospheric trace species such as OH, sulfur oxides, nitrogen oxides, CO, and aerosols For proper interpretation of field measurements all relevant meteorological parameters must also be well characterized Program goals are described in NASA RP 1062 The plan is to first provide technology development of the needed instrumentation before performing extended field measurements Developments for both low-altitude and medium-altitude (upper troposphere) aircraft will be stressed

W83-70251 **146-60-00**
Goddard Space Flight Center, Greenbelt, Md
METEOROLOGICAL SATELLITE DATA RESEARCH
Ernest A Neil 301-344-6291

The objective of this research is to exploit satellite observations of the atmosphere to initialize, verify and improve models, diagnose atmospheric processes, assess the impact of satellite data on forecast accuracy, and to increase understanding of atmospheric behavior The genesis, development, maturation and decay of organized large-scale weather systems will be studied and numerical experiments will be conducted to assess the usefulness of satellite observing systems The performance of various predictive models will be assessed and the resolution and realism of general circulation models will be improved Expected results include more realistic model parameterizations, improved analysis techniques, diagnostic studies, model skill evaluations, and improved forecast models

W83-70252 **146-61-00**
Marshall Space Flight Center, Huntsville, Ala
METEOROLOGICAL SATELLITE DATA RESEARCH AND APPLICATIONS
W W Vaughan 205-453-3100

The objective of this research is to contribute to the NASA Global Weather Research program objectives by performing diagnostic and theoretical studies of global-scale atmospheric systems to (1) develop new and improved spaceborne atmospheric sensing techniques, (2) develop new techniques to extract information from and more fully utilize existing and planned spaceborne atmospheric sensing systems, and (3) contribute to the development of understanding of global weather processes Detailed diagnostic studies will be conducted with satellite and ground-based data sets, guided by theoretical studies to understand the role of latent heat release, in the dynamics of cyclones Global weather processes will be examined to gain improved understanding of the scales of motion and to develop techniques for including satellite data in diagnostic procedures

W83-70253 **146-64-00**
Goddard Space Flight Center, Greenbelt, Md
GLOBAL WEATHER EXPERIMENT DATA PROCESSING AND RESEARCH
Ernest A Neil 301-344-6291

The objective of this RTOP is to support research investigations by the Academic community and NASA investigators utilizing the FGGE data base, provide advanced computational techniques and equipment to support such research, and investigate new data sources for incorporation into global circulation models In addition it is intended to continue support of outside investigator's proposals for research utilizing the FGGE data base through Peer Review of submitted proposals, continue operating of the modeling and simulation computer facility in support of university and in-house atmospheric research efforts, procure, check out and operate a new high speed vector processor in support of university and NASA atmospheric research programs, investigate new and novel data processing techniques and advanced data sources for applicability to global circulation models Also, continued research support to the academic community and check out, programming and operation of a HSVP computational facility in support of NASA's atmospheric research program is planned

W83-70254 **146-65-00**
Goddard Space Flight Center, Greenbelt, Md
METEOROLOGICAL PARAMETER EXTRACTION
Ernest A Neil 301-344-6291

The objective of this RTOP is to develop new and improved techniques for retrieving useful parameters from satellite-measured radiances and to interpret these retrievals to provide information on the state and motion of the atmosphere Investigations and case studies are planned to develop interpretative information and establish relationships between satellite radiances and atmospheric processes and to develop advanced algorithms to perform the required transformations Research in methods to determine temperature, moisture, wind and precipitation from measurements of various portions of the electromagnetic spectrum is proposed Other objectives include methods and techniques to improve the accuracy and resolution of satellite measured radiance data to improve the accuracy and utility of such data and to develop new techniques to provide additional physical parameters from radiance data and establish the limits of radiance data accuracy achievable by satellite means

W83-70255 **146-66-01**
Jet Propulsion Laboratory, Pasadena, Calif
NUMERICAL ANALYSIS OF REMOTE SENSING DATA
M T Chahine 213-354-2433

The main objective of the proposed investigation is to develop rapid retrieval algorithms for accurate interpretation of remote sounding radiance data measured by the various NASA and NOAA weather satellites The components of the retrieval algorithms will consist of individual numerical methods dealing with (1) application of analytical techniques to separate the effects of clouds from the radiance data measured in the pressure of partial cloud covers (2) development of a three dimensional quality control approach to filter out spurious temperature profiles, (3) adaptation of the resulting temperature profiles to the requirements of the GLAS-GCM to demonstrate the impact of remote sounding data on weather forecasting, (4) retrieval of accurate sea surface temperature using the 3 7 micron window, (5) derivation of three dimensional global maps of the distribution of the amounts and heights of clouds, (6) improving the accuracy of computed atmospheric transmission functions needed for interpretations, using spectral data measured by the JPL High Speed Interferometers, and (7) investigating a new approach to derive air-sea surface temperature differences at the surface, using data from the HIRS II instrument

W83-70256 **146-70-00**
Goddard Space Flight Center, Greenbelt, Md
METEOROLOGICAL OBSERVING SYSTEM DEVELOPMENT
S H Melfi 301-344-6348

The objective of the proposed investigation is to develop new and improved spaceborne remote sensing systems in support of the NASA Global Weather Program and to develop improved data processing and retrieval techniques to provide for more accurate understanding of processes which influence the state and behavior of the atmosphere Theory, laboratory measurements, and field experiments will be used to define, develop, and evaluate new and improved remote sensing techniques to observe profiles of atmospheric temperature, moisture, and pressure, precipitation, surface properties, and atmospheric radiative properties Infrared visible and microwave, and passive modes will be studied Evaluation, in cooperation with other scientists, will be performed to assess improvement in weather forecasting Expected results include improved techiniques and instrumentation to observe profiles of atmospheric temperature, moisture, and pressure as well as precipitation, surface properties, and atmospheric radiative properties leading to improved weather prediction

W83-70257 **146-71-00**
Goddard Space Flight Center, Greenbelt, Md
VERIFICATION AND ANALYSIS OF SATELLITE DERIVED PRODUCTS
F J Schmidlin 804-824-3411

The objectives are to (1) provide meteorological rawinsonde and rocketsonde measurements for comparison, verification, and calibration of the Operation Environmental Satellite Instruments (i e , NOAA-7), (2) using data from Wallops and other rocketsonde sites compare, analyze, and interpret the measurements, including assessing the reliability and precision of the in situ instruments, (3) demonstrate methods to enhance the applicability of TOVS data, and (4) provide meteorological rocketsonde data in support of space shuttle reentry analysis Unique rawinsonde and rocketsonde measurements obtained at WFC between 1980 to 1983 during satellite overpass are to be used as a control on comparisons of in situ satellite data obtained at the MRN rocketsonde sites Argentina, Brazil Norway, Sweden and USSR data will provide additional data covering wider geographic distribution Statistical analysis of the measurement pairs will continue with a report expected early in FY-83 Data obtained during the 30 day series launched in FY-83 will be analyzed to demonstrate the applicability of satellite data Expected results are new and/or additional information on the precision of the rawinsonde and rocketsonde, a better understanding of the influence of atmospheric space/time variability on satellite data verification, new knowledge on the reliability and accuracy of retrieved temperature data from satellites, recommendations to enhance the utilization of the satellite data

W83-70258 **146-72-01**
Jet Propulsion Laboratory Pasadena, Calif
GLOBAL WEATHER RESEARCH - MICROWAVE PRESSURE SOUNDER
D A Flower 213-354-4151

This RTOP supports the second phase of the MPS research program, the objective of which is to develop an instrument for the remote measurement of atmospheric pressure at the Earth's surface Surface pressure is an important meteorological parameter but no method at present exists for its remote measurement Extensive design studies have shown that differential absorption measurements in the wings of the 60 GHz oxygen absorption band are potentially capable of providing surface pressure observations with the accuracy and coverage suited to applications in global weather research and operational weather forecasting The specific objectives of this phase of the investigation are verification of the pressure measuring concept, characterization of the performance of an aircraft version of the MPS, a satellite instrument definition study, and the advanced developed of critical components The approach will be to use the results from a series of CV-990 test flights with the MPS aircraft instrument, to verify theoretical relationships between the measured millimeter-wave absorption of the atmosphere and its meteorological parameters This series of CV-990 test flights in a range of atmospheric types will be used to fully characterize the performance of the MPS instrumentation Results from these experiments will be applied to previously developed optimization procedures for selecting the operating frequencies of a satellite MPS A hardware design of this instrument will be produced together with flight experiment plans for testing, spacecraft integration, data analysis, management and cost A special study of the antenna design will be undertaken Development work will be initiated on the combination of IMPATT diodes in a single device to provide millimeter-wave oscillators with an output power of about 2W

W83-70259 **146-72-02**
Jet Propulsion Laboratory, Pasadena, Calif
GLOBAL WEATHER RESEARCH - ADVANCED MOISTURE AND TEMPERATURE SOUNDER (AMTS)
M T Chahine 213-354-2433

The ultimate objective of this effort is to develop an infrared advanced moisture and temperature sounder (AMTS) which meets the requirements of the numerical weather prediction models of the late 1980's These models require global atmospheric temperature profiles with an accuracy of 1K and with a vertical resolution comparable to that of radiosondes This accuracy and vertical resolution requirement, which is not satisfied by current sounders, is achievable with the AMTS concept by careful choice of narrow band infrared channels utilizing the dependence of the absorption coefficients on pressure and temperature Improvements in the vertical resolution of tropospheric temperture profiles to meet numerical weather prediction requirements are obtained from measurements with a resolution of 2 cm(-1) in high J-lines of the R-branch of the 4 3 microns CO2 band A complementary set of 15 microns channels with a spectral resolution of 0 5 cm(-1) is used to sound the upper troposphere and stratosphere Elimination of the effects of clouds is accomplished by taking simultaneous measurements in the 4 3 and 15 microns bands During the past years we have developed designs for a stand-alone AMTS for a low earth orbiter (LEO) During FY-82 we continued the development of the AMTS by evaluating the performance of a combined infrared/microwave sounder system for a LEO In parallel with this we continued the evaluation of the magnitude of various random and systematic errors in the radiometry of the baseline design During FY-83 we propose to concentrate our effort on an AMTS system study, that is the interaction between hardware capability, end user need and ground data processing, envisioned by the user or necessitated by hardware or mission constraints

W83-70260 **146-72-04**
Jet Propulsion Laboratory, Pasadena, Calif
TROPOSPHERIC WIND MEASUREMENT ASSESSMENT
E D Hinkley 213-354-3555

The objective of this program is to evaluate certain aspects of an active laser technique for global measurement of tropospheric wind fields This technique, based on long range Doppler lidar using pulsed lasers, has the potential for providing global wind data from an orbiting platform Several types of remote measurements of atmospheric wind velocities have been analyzed, e g , passive microwave, millimeter wave, infrared radiometry, and active visible and infrared range-gated lidar, with the results indicating that the technique (using CO2 lasers or others with similar characteristics), was the superior technique for tropospheric wind field measurements During FY-83, the work will continue on an experimental study of vertical profiles of atmospheric aerosol backscatter at various CO2 laser wavelengths in the 9 to 11 micron region This study will be conducted using an existing TEA CO2 lidar facility, employing a single longitudinal mode injection-controlled TEA laser transmitter and a heterodyne receiver The mini-TEA laser will be used in a ring laser configuration to study its properties when injection locking is employed, and design of an interface between this laser and the airborne MSFC system will be performed in preparation for future collaborative measurements

W83-70261 **146-72-05**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED MICROWAVE SENSING OF METEOROLOGICAL PARAMETERS
R K Kakar 213-354-7748

The objective of the proposed research is to specify a future operational microwave sounder (FOMS) system that will serve as a

successor to the currently operational microwave sounding unit The primary objective for the FOMS system will be to provide global data on temperature and water vapor profiles for synoptic weather forecasting In addition, precipitation intensity and distribution, integrated water content and cloud liquid water will also be measured The previously proposed advanced microwave sounding unit (AMSU) will serve as a baseline for the specification of FOMS Theoretical and experimental studies will be performed to optimize the capability of the FOMS system The necessary measurement program will be carried out with the suitably modified airborne advanced microwave moisture sounder developed by the Georgia Institute of Technology

W83-70262 **146-73-00**
Marshall Space Flight Center, Huntsville, Ala
METEOROLOGICAL OBSERVING SYSTEM DEVELOPMENT
R G Eudy 205-453-0514

The objective of this research is to contribute to the NASA Global Weather Research program by performing fundamental studies aimed at improving our ability to measure synoptic-scale atmospheric wind flow on a global basis Utilizing the talents of university and private contractor groups plus the MSFC in-house talents and laboratory capabilities, specific research activities as described in the tasks of this RTOP will be accomplished

W83-70263 **146-74-01**
Langley Research Center, Hampton, Va
METEOROLOGICAL LIDAR DEVELOPMENT
E V Browell 804-827-2576

The objective of this RTOP is to developed lidar techniques for remote measurements of water vapor profiles in the lower atmosphere This research program will have as its main emphasis the investigation of near-IR DIAL techniques for airborne/space-borne water vapor profiling The airborne differential absorption lidar (DIAL) system will be modified for application to water vapor DIAL measurements in the 940 nm wavelength region Performance of an Alexandrite laser versus a Nd YAG-pumped dye laser will be evaluated for measurement of water vapor profiles Techniques will be investigated for the generation of laser output near 1140 nm for DIAL measurements of water vapor Simulations will be conducted to evaluate the DIAL measurements of water vapor in the 720, 940, and 1140 nm wavelength regions from airborne and spaceborne platforms

W83-70264 **146-76-00**
Marshall Space Flight Center, Huntsville, Ala
STUDIES OF DYNAMICS OF ATMOSPHERIC FLOWS
W W Vaughan 205-453-3100

The objective of this RTOP is to contribute to the NASA Global Weather Research program by performing fundamental studies aimed at improving our understanding of large scale atmospheric dynamics Studies applicable to the scientific design and interpretation of spherical laboratory models of large scale geophysical flows will be conducted These spherical models must be operated in a low gravity environment since the radial dielectric body force used to simulate gravity is weak Two models are being prepared for Spacelab flights The geophysical fluid flow cell (GFFC) is concerned with convective instability in vertically unstable atmospheres, and the atmospheric general circulation experiment (AGCE) is concerned with baroclinic instability in vertically stable atmospheres

Upper Atmospheric Research Program

W83-70265 **147-10-03**
Ames Research Center, Moffett Field, Calif
ATMOSPHERIC PROCESSES, EXPERIMENTS AND SYSTEMS
Boris Ragent 415-965-5404
(146-10-04, 146-20-10)

The research objectives are to perform studies of stratospheric transport, and tropospheric stratospheric exchange processes, and to obtain benchmark data on important atmospheric species Observational data from balloon, aircraft, and satellite instrumentation are utilized Measurements are made of the meteorological field parameters, winds, temperature, pressure and atmospheric tracer species such as CFMS, N2O, water vapor, O3, CO, and aerosols Coordinated simultaneous measurement sets are emphasized The current interest is stratospheric water vapor transport and wave vapor budget The approach is to form experiment working groups composed of experiment principal investigators and additional experts in atmospheric processes Workshops are then held, appropriate experiments are designed to study important processes, some new instrumentation is developed as appropriate, cooperative experiments are conducted, and the results are subsequently analyzed, and published Typical experiment platforms are NASA's U-2, ER-2, and CV-990 aircraft

W83-70266 **147-11-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - FIELD MEASUREMENTS
William S Heaps 301-344-5106

The objective of this RTOP is to determine specific local chemical and physical interactions in the atmosphere using coordinated in-situ measurement campaigns from balloon platforms, specifically with respect to the OH radical, and related species This will be accomplished through the development of a balloon-borne lidar system for the measurement of trace species, especially OH and ozone and the direct measurement of photolysis rates of importance in the atmosphere The research will result in the determination of absolute concentration measurements of key trace species and validation of the photochemical models

W83-70267 **147-11-04**
Jet Propulsion Laboratory, Pasadena, Calif
STRATOSPHERIC RESEARCH, BALLOON LASER IN-SITU SENSOR
R T Menzies 213-354-3787

The primary objective of the balloon laser in-situ sensor task is to obtain reliable data on the concentrations and distributions of the minor and trace species in the stratosphere These data are to be used by modelers and dynamicists to assess and predict the effects of change in the chemical contents of the stratosphere due to man's activities This instrument uses tunable infrared diode lasers to measure absorption due to selected species between a balloon gondola and a lowered retroreflector An optical tracking system stabilizes the laser beam on the retroreflector Several species can be measured in this manner, throughout a diurnal cycle

W83-70268 **147-11-05**
Lyndon B Johnson Space Center, Houston, Tex
IN-SITU MEASUREMENTS OF STRATOSPHERIC OZONE
D E Robbins 713-483-5039

The objective of this research is to measure ozone in-situ from multisensor balloon-borne platforms to participate in coordinated studies to validate photochemical models of stratospheric ozone, and to intercompare results with those from other techniques Ozone measurements will be made using an existing instruments as a piggyback experiment on platforms carrying experiments measuring other species of interest to stratospheric ozone chemistry The ozone instrument is a modified Dasibi which pulls air through an enclosed cell where the ozone mixing ratio is measured by UV photometry

W83-70269 **147-12-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - FIELD MEASUREMENTS
J E Mentall 301-344-8959

The objectives of this research are to (1) determine the specific local chemical and physical interactions in the atmosphere by a combination of theoretical studies and coordinated in situ measurement campaigns from rocket and balloon platforms, (2) investigate the variations and perturbations of the chemical and physical state of the atmosphere, i e, variations with altitude, solar conditions, season, latitude, and perturbations from volcanoes, tropical storms, industrial and agricultural activity, and (3) develop and calibrate selected instruments for local and remote investigations of the atmosphere The approach will be to (1) develop a balloon-borne Michelson interferometer to measure the concentrations and diurnal variations of trace stratospheric species, (2) develop a pointed spectrometer system to measure the solar photon flux within the stratosphere, and (3) perform multiinstrument, coordinated measurements on minor species in the stratosphere One dimensional photochemical models to compare experimental results with theoretical predictions will be developed The research will result in the improvement and validation of photochemical models, improvement of understanding of upper atmosphere dynamics and transport, and the determination of in situ solar flux and the accuracy of radiative transfer calculations

W83-70270 **147-12-05**
Jet Propulsion Laboratory, Pasadena, Calif
STRATOSPHERIC FOURIER SPECTROSCOPY AT NEAR AND MID IR WAVELENGTHS
C B Farmer 213-354-2039

The primary objective of this task is to obtain reliable data on the concentration and distribution of minor and trace species in the Earth's upper atmosphere These data are provided for use by modelers and dynamicists to assess and predict the effects of changes in the chemical contents of the stratosphere due to man's activities The emphasis of

this task is placed on the simultaneous determination of profiles of a large number of related families of photochemical species with sufficient accuracy to permit seasonal variations to be detected Compositional data are determined from infrared absorption spectra in the 2 5 to 16 micron region at a resolution of 0 01 cm(-1) obtained by observing the Sun through long stratospheric paths at sunset or sunrise from high altitude balloons The instrument is a continuous scan Michelson interferometer which can obtain data in 80 second time intervals, fast enough to result in a vertical height discrimination of better than 2 km The instrument's throughput is such as to produce spectra which have signal to noise ratios in excess of 200 1 througout

W83-70271 **147-12-06**
Jet Propulsion Laboratory, Pasadena, Calif
STRATOSPHERIC RESEARCH, FIELD MEASUREMENTS PROGRAM· MILLIMETER AND SUBMILLIMETER RADIOMETRY
J W Water 213-354-3025

The objective of this program is to improve understanding of Earth's upper atmosphere by microwave measurement techniques at millimeter and submillimeter wavelengths Well founded concerns that man's technological activities may perturb upper atmospheric balances, particularly those maintaining stratospheric ozone, justify this objective The approach is to first determine which measurements are needed for atmospheric research and perform calculations to define which subset of these can be usefully performed by microwave techniques A field program is then established for those measurements of sufficient use The field program may involve instrument development or improvement One important goal of this program is to determine both the capabilities and limitations of microwave techniques so they can be used efficiently in NASA's overall upper atmosphere research program The plan of this research program for the current year is to use the existing JPL balloon microwave limb sounder (BMLS) in a NASA-coordinated measurement program to improve understanding of how chlorine from industrial sources might deplete stratospheric ozone The BMLS operates simultaneously in three spectral bands near 205 GHz to measure thermal emission from ClO, O3, and tentatively, H2O2

W83-70272 **147-12-08**
Jet Propulsion Laboratory, Pasadena, Calif
PRESSURE MODULATOR RADIOMETER
H K Roscoe 213-354-3025

The Oxford balloon-borne pressure modulator radiometer (BPMR) vertical profiles of minor stratospheric constituents by sensing thermal emission from the atmospheric limb Its current capability includes measurements of NO and NO2, where sensitivity and selectivity are incrased by means of pressure modulators, and of HNO3, ClNO3 and N2O5, where a novel selective filter removes interfering signals from CH4 and N2O Objectives in 1980 and 1981 were to measure these constituents for as much of the day-night cycle as possible, and to compare the results with other instruments making simultaneous measurements A further objective was to measure in the laboratory the response of the radiometer to each constituent over a wider range of pressures and temperatures tha hitherto, and to remeasure the response to interfering CH4 and N2O In spring 1981 BPMR flew on a gondola with the National Physical Laboratory's cooled grating spectrometer Excellent NO and NO2 ata were received from mid-day until the flight termination at 2 a m Unsatisfactory procedures in the data analysis programs have prevented the retrieval of profiles as yet, the rapid changes in both NO and NO2 radiances near sunset can be clearly seen For the first time, the slower change in radiance at N2O5 wavelengths was observed If interpreted as due to N2O5, the profile deduced from this signal and the time constant of the night-time increase agree remarkably with model predictions

W83-70273 **147-15-00**
Goddard Space Flight Center, Greenbelt, Md
SOLAR FLUX IN UPPER ATMOSPHERE
J E Mentall 301-344-8959

The objective of this RTOP is to determine the transmission of the Earth's atmosphere in the molecular oxygen Schumann-Runge bands Using a spectrometer pointed at Sun from a high altitude parachute, the transmitted photo flux in the wavelength region 180 to 300 nm is measured as a function of altitude The transmitted photon flux is compared with the predicted flux using absorption cross sections measured in the laboratory This comparison provides a sensitive test of the accuracy of the absorption cross sections when the optical depth is greater than one

W83-70274 **147-16-01**
Jet Propulsion Laboratory, Pasadena, Calif
MULTI-SENSOR BALLOON MEASUREMENTS
W T Huntress 213-354-8275
(147-12-05, 147-12-06, 147-12-08)

A continuing series of stratospheric balloon flights is conducted to measure the abundance and altitude distribution of key chemical constituents in the upper atmosphere A modular gondola system is used to carry a multiinstrumented package consisting of several JPL remote sensing instruments, or instruments from other institutions in the U S and abroad, configured for a particular scientific purpose for any one flight Data are obtained on the altitude profiles for a number of chemically coupled species all at the same time and in the same air mass for instrument intercomparison purposes and for the validation of atmospheric chemical models

W83-70275 **147-18-02**
Jet Propulsion Laboratory, Pasadena, Calif
GAS CORRELATION WIND SENSOR
D J McCleese 213-354-2317

The objective of this task is the development of a measurement technique for remote sensing of stratospheric and mesospheric winds from spacecraft The approach is through the continued laboratory development and test of a gas correlation spectroradiometer This instrument measures the wind induced Doppler shift in atmospheric thermal emission spectra of selected molecular species (e g N2O and CO2) Previous numerical and laboratory studies of this technique conducted at JPL indicate that wind measurements can be made in the 20 to 120 km altitude interval with an accuracy of better than 5 m/s The gas correlation wind sensor is also capable of making simultaneous measurements of atmospheric temperature and trace species abundance profiles in the upper atmosphere These capabilities will also be developed in the laboratory

W83-70276 **147-20-03**
Ames Research Center, Moffett Field, Calif
QUANTITATIVE INFRARED SPECTROSCOPY OF MINOR CONSTITUENTS OF THE EARTH'S STRATOSPHERE
Charles Chackerian, Jr 415-965-5510

Remote detection and measurement of stratospheric species via spectroscopic techniques is being routinely employed to develop a better understanding of this portion of our atmosphere and man's effect upon it Proper interpretation of these measurements relies strongly on having the correct laboratory data The objective of this work is to obtain laboratory measurements of basic molecular parameters, such as rotational line intensities and half-widths, absorption band intensities, vibrational and rotational constants, vibration-rotation interaction constants, line position measurements including pressure induced shifts, and Franck-Condon factors The determination of these parameters, and their dependence on pressure and temperature, will be obtained by using long path gas cells, cooled and heated cells, and high resolution interferometers and spectrometers

W83-70277 **147-21-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - REACTION RATE MEASUREMENTS
L J Stief 301-344-7529

The objective of this RTOP is to measure chemical kinetic rate coefficients of importance to the stratosphere and mesosphere The laboratory effort in chemical kinetics uses existing equipment of unique capability for the purpose of measuring absolute rate constants of reactions of importance in current models of the stratosphere Rate constants of atom-molecular and radical molecule reactions are measured as a function of temperature and pressure and under conditions in which the number of atoms or radicals is much less than the number of molecules A new research direction will be investigated, namely radical-atom and radical-radical reactions of novel species whose reactivities as yet are virtually unknown This new direction will necessitate the acquisition of a mass spectrometer system for incorporation into out discharge flow apparatus Addition of mass spectrometry for detection, monitoring, and direct analysis of reaction products (coupled with our current approach of following reactants) will add a new dimension to our capability This will allow us to determine reaction channels and provide direct evidence for elucidation of reaction mechanisms

W83-70278 **147-21-03**
Jet Propulsion Laboratory, Pasadena, Calif
CHEMICAL KINETICS OF THE UPPER ATMOSPHERE
W B DeMore 213-354-2436

The objectives of this research are to obtain direct measurements of rate constants and temperature dependences for reactions of HO(x),

NO(x), ClO(x), BrO(x), and FO(x) in stratospheric chemistry, and to develop techniques for laboratory study of relevant transient species

W83-70279 **147-22-01**
Jet Propulsion Laboratory, Pasadena, Calif
PHOTOCHEMISTRY OF THE UPPER ATMOSPHERE
W B DeMore 213-354-2436

The objective is to conduct laboratory studies of stratospheric photochemistry, including absorption cross sections, photolytic quantum yields, reaction mechanisms, and product distributions

W83-70280 **147-23-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - LABORATORY MEASUREMENTS
T J McGee 301-344-5645

The tasks of this research are (1) to support ongoing lidar experiments, (2) to perform laboratory studies to test the feasibility of measurements of additional species (3) to test and calibrate new instruments, and (4) measurement of UV absorption cross sections of importance in atmospheric photochemistry The approach will be to measure spectroscopic parameters of importance atmospheric constituents in all regions of the spectrum from the VUV to submillimeter waves Studies will be performed in both absorption and emission Quantitative spectroscopic data will be measured for a more accurate interpretation of current field experiments and to demonstrate the feasibility of new field measurements

W83-70281 **147-23-08**
Jet Propulsion Laboratory, Pasadena, Calif
INFRARED LABORATORY SPECTROSCOPY IN SUPPORT OF STRATOSPHERIC MEASUREMENTS
R A Toth 213-354-2140
(147-10-02)

The program involves the acquisition and analysis of molecular spectral parameters which are required for the interpretation of data from stratospheric measurements The laboratory spectral measurements will be conducted specifically in support of the JPL infrared interferometers These instruments have requirements relative to spectral region of operation, spectral resolution, and molecules for which it is best suited Emphasis is placed on accuracy of line frequency, line width, and line strength measurements, in order to take full advantage of spectroscopic techniques for quantitative atmospheric species measurements A large portion of the spectral data will also be of value to other groups who use spectroscopic instruments for atmospheric measurements

W83-70282 **147-23-09**
Jet Propulsion Laboratory, Pasadena, Calif
LASER LABORATORY SPECTROSCOPY
J S Margolis 213-354-3616

The program involves the acquisition and analysis of molecular spectral parameters which are required for the interpretation of data from laser stratospheric measurements Specifically the type of laser stratospheric instruments supported are the LHR and the balloon laser in-situ sensor The spectral parameters measured are line positions, absorption strength and air broadening

W83-70283 **147-23-10**
Jet Propulsion Laboratory, Pasadena, Calif
MILLIMETER/SUBMILLIMETER LABORATORY SPECTROSCOPY
E A Cohen 213-354-4701

A program of laboratory studies related to stratospheric research will be conducted in millimeter and submillimeter spectroscopy The program involves the acquisition and analysis of molecular spectral parameters which are required for the interpretation of data from stratospheric measurements The laboratory spectral measurements will be conducted specifically in support of the JPL millimeter radiometer instruments Emphasis is placed on accuracy of line frequency, line width, and transition movement measurements, in order to take full advantage of spectroscopic techniques for quantitative atmospheric species measurements A large portion of the spectral data will also be of value to other groups who use spectroscopic instruments for atmospheric measurements

W83-70284 **147-30-02**
Ames Research Center, Moffett Field, Calif
STRATOSPHERIC RESEARCH
E F Danielsen 415-965-5527
(147-20-03, 146-10-04)

The objective of this research is to increase our understanding of the dynamics, thermodynamics and composition of the Earth's stratosphere and mesosphere with emphasis on atmospheric transport and its effects on the distributions of energy, momentum and trace constituents, such as water vapor, ozone, etc The research includes development of numerical, predictive and diagnostic models in three dimensions The predictive, spectral model, being developed at Ames, is sufficiently general to permit analysis of the effects on the stratosphere of waves generated in the troposphere by baroclinic instability or surface topography An much simpler model of the middle atmosphere developed at the University of Washington emphasizes low wave number interactions in the stratosphere and mesosphere The diagnostic models being developed at San Jose State and Ames will be applied both to actual atmospheric observations and to predictions made by the NOAA-GFDL general circulation model From both data sets, vertical as well as horizontal velocities will be derived and analyzed statistically for transport parameterizations in 2-dimensional models Complementary to these large scale studies, radiosonde and U-2 measurements from experiments conducted in the tropics are being analyzed for mesoscale transpots and tropospheric-stratospheric exchange in the tropics Ab initio computations of molecular processes important to stratospheric photochemistry are also being carried out

W83-70285 **147-31-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - THEORETICAL STUDIES
R S Stolarski 301-344-5485

This research will (1) provide the framework for developing and understanding an organized, solid body of knowledge of the physics, chemistry, and dynamics of the Earth's upper atmosphere, (2) analyze data from upper atmospheric flight programs and (3) predict and assess the effects of natural and man related perturbations on the atmosphere The approach will be to (1) continue to develop and utilize a hierarchy of models of upper atmospheric photochemistry and radiation ranging from simplified models to the incorporation of chemistry into a global general circulation model, and (2) utilize field measurement data to elucidate the controlling mechanisms for atmospheric composition and variations The studies will result in improved photochemical models, and an improved understanding of the coupling between chemistry and transport

W83-70286 **147-32-00**
Goddard Space Flight Center, Greenbelt, Md
GENERAL CIRCULATION MODELING OF THE STRATOSPHERE
M A Geller 301-344-8399

The objectives of this RTOP are to provide the framework to understand the natural stratosphere and its response to external perturbations and enhance our understanding of the two-way interactions between troposphere and stratosphere The approach will be to develop computer general circulation models of the troposphere-stratosphere system and analyze stratospheric satellite data to compare against model output These studies will lead to an improved understanding of the stratospheric radiative-chemical-dynamic system

W83-70287 **147-41-00**
Goddard Space Flight Center, Greenbelt, Md
UPPER ATMOSPHERE RESEARCH - SATELLITE DATA ANALYSIS
S Chandra 301-344-8743

This research involves the analysis and interpretation of satellite data to understand the behavior of ozone and the other related parameters in the stratosphere and the mesosphere The approach will be to (1) continue to develop analytical empirical models of stratospheric ozone and temperature obtained from Nimbus 4 and Nimbus 7 in which these parameters are expressed in Fourier and spherical harmonics representing time, latitude and longitude, (2) continue the correlative study of ozone and temperature fields on various time scales using frequency spectral analysis, and (3) develop a detailed analysis system of the stratosphere using a multivariate optimum interpolation analysis scheme

W83-70288 **147-43-00**
Goddard Space Flight Center, Greenbelt, Md
CRITICAL EXAMINATION OF UPPER STRATOSPHERIC MEASUREMENTS
J E Frederick 301-344-8232

The research will (1) provide information on the accuracy of results obtained by present satellite-borne ozone remote sensors and investigate means of distinguishing changes in instrument sensitivity from geophysical effects, (2) analyze the manner in which changes in ozone of natural and anthropogenic origin will manifest themselves in radiances monitored by orbiting backscatter ultraviolet spectrometers, and (3) perform analyses of the available waver vapor, hydroxyl radical, and nitric oxide data bases to seek behavior which could also appear in the ozone record The approach will be to (1) perform analyses of

backscatter ultraviolet radiances to delineate both their errors bars and information content, (2) couple a radiative transfer code to an existing one-dimensional photochemical-transport model to compute simulated backscattered radiances for direct comparison with satellite measurements, and (3) perform trend analyses of the available 17 year data set of stratospheric water vapor and tropical tropopause temperature The studies will result in (1) improved understanding of the manner in which true changes in ozone will manifest themselves in a long term BUV radiance data base and how these changes can be distinguished from instrumental artifacts (2) improved understanding of possible relationships between long term trends in water vapor, tropical tropopause temperature, and ozone

W83-70289 **147-44-00**
Goddard Space Flight Center, Greenbelt, Md
SPECTROSCOPIC PROPERTIES OF THE STRATOSPHERE
R McPeters 301-344-8203

This RTOP seeks to understand the spectroscopic properties of the stratosphere to 1% accuracy Tasks include (1) analyzing continuous spectral scan data from Nimbus 7 SBUV by inverting ozone profile for each scan, and calculating Rayleigh-ozone backscatter to obtain residual radiance tape Possible sources of residual radiance, including nitric oxide emissions will be examined in an effort to improve understanding of ozone backscatter

W83-70290 **147-51-00**
Goddard Space Flight Center, Greenbelt, Md
ASSESSMENT OF OZONE PERTURBATIONS
R S Stolarski 301-344-5485

To provide continued update assessments of the status of knowledge of the stratosphere and of how the NASA research program has contributed to this knowledge, workshops will be organized at intervals of 2 to 4 years as determined by NASA Headquarters Continuity between workshops in the in-situ measurements data base started during the 1981 workshop will be maintained Long-range planning discussions for the next workshop will be held The in-situ data base will be improved and updated

W83-70291 **147-51-02**
Jet Propulsion Laboratory, Pasadena, Calif
DATA SURVEY AND EVALUATION
W B DeMore 213-354-2436

An up-to-date tabulation and critical evaluation of kinetic and photochemical data relevant to the stratosphere will be maintained for use by atmospheric modelers, to aid in the establishment of research priorities, and to identify gaps or inconsistencies in the data base

Planetary Geology R&A

W83-70292 **151-01-70**
Jet Propulsion Laboratory, Pasadena, Calif
PLANETARY GEOLOGY
R S Saunders 213-354-3815

This research uses the planetary data base from Viking, Voyager, and other missions to understand the geologic history of the terrestrial planets In addition to data analysis, experiments and theoretical analyses are used to help guide and constrain the interpretations Comparative studies are emphasized

Planetary Materials

W83-70293 **152-01-40**
Lyndon B Johnson Space Center, Houston, Tex
PLANETARY MATERIALS ANALYSIS
J W Dietrich 713-483-3274

Analysis of planetary samples is a multidisciplinary effort carried out by individual scientists and teams from universities, industries, and government agencies Most individuals and scientific teams work with two or more types of extraterrestrial material in achieving the objectives of their proposed research The three types of planetary materials studied (with estimated number of grants/contracts that include analyses of that type of material) are (1) lunar samples (30 grants/contracts), (2) meteorites (40 grants/contracts), and (3) cosmic dust (6 grants/contracts) The analysis of planetary samples is part of a continuing effort focused on improving our understanding of the origin and history of the Moon, Earth, and Solar System This includes determining the age, chemical and mineralogical composition, and physical properties of available samples of extraterrestrial material Data obtained provide valuable information on the history of the Sun and refine baseline data for planetary processes that will aid in the planning of future planetary missions

W83-70294 **152-02-40**
Lyndon B Johnson Space Center, Houston, Tex
PLANETARY MATERIALS: LABORATORY AND ANALYTICAL STUDIES
R J Williams 713-483-2781
(152-04-40, 153-06-40)

The objective of this research is to produce a quantitative understanding of the chemical and physical properties of planetary materials and of the processes by which these materials have been formed and evolved This quantitative understanding is obtained through analytical studies of lunar samples, meteorites, cosmic dust, and closely related synthetic or terrestrial materials A variety of analytical techniques--X-ray fluorescence, instrumental neutron activation, solid source and gas mass spectrometry, gas chromatography, ion and electron microprobe analysis, and scanning and transmission of electron microscopy--are used, as appropriate, to quantitatively determine the physical, chemical, and mineralogical properties of planetary materials

W83-70295 **152-03-60**
Ames Research Center, Moffett Field, Calif
STUDIES OF THE DISTRIBUTION OF ELEMENTS AND MINERAL PHASES AMONG METEORITES
H P Klein 415-965-5094

The objectives are to understand the origin and evolution of meteorites through the study of their chemistry and mineralogy and to gain insight into the conditions and processes that prevailed at the time of the solar system's origin The abundance, isotopic composition and distribution of selected elements and the occurrence and distribution of various minerals in meteorites will be examined Systematic searches for elemental, isotopic and mineralogic-petrologic correlations between meteorites and within a meteorite will be made so as to elucidate physical-chemical relationships in the meteorite population These relationships will be used to test the hypothesis that meteorites originated as condensates from the cooling solar nebula

W83-70296 **152-04-40**
Lyndon B Johnson Space Center, Houston, Tex
CURATION OF EXTRATERRESTRIAL SAMPLES
D P Blanchard 713-483-3274

Care of extraterrestrial samples involves (1) maintenance of the lunar sample collection under secure, controlled environment conditions, (2) the description of samples as new materials are prepared for analysis, (3) the maintenance of records of the status and distribution of lunar samples, and the dissemination of lunar samples to approved investigator as well as for display purposes The technical monitoring of NASA-funded grants/contracts to extraterrestrial materials investigators is also accomplished Similar functions are also performed for the Antarctic meteorite collection, including initial description, processing for distribution to investigators, and maintenance under controlled environment, dissemination of information on meteorite collection, and staff participation in field collection Cosmic dust samples are collected and characterized using high altitude aircraft for distribution to scientific investigators, for dissemination of information and provides for development of curatorial techniques for, and education use of, materials from the various collections Operation, which is undertaken by support contractor personnel, is directed by Civil Servant scientists and administrators Samples and information are distributed for about 65 domestic and foreign lunar sample investigator groups, over 100 meteorite investigator groups, and 6 to 10 cosmic dust investigators

W83-70297 **152-05-40**
Lyndon B Johnson Space Center, Houston, Tex
JSC GENERAL OPERATIONS SUPPORT - PLANETARY MATERIALS
M B Duke 713-483-4464

This plan provides for support by JSC of a general operational nature necessary to the conduct of the OSSA Planetary Materials Program It provides in-house laboratory support and Center Operations support for the visiting scientist programs of the NASA (National Research Council, Lunar and Planetary Institute, NASA Graduate Intern, etc) and to the Sample Curator

Geochemistry/Geophysics R&A

W83-70298 **153-01-60**
Ames Research Center, Moffett Field, Calif
FORMATION, EVOLUTION, AND STABILITY OF PROTO-STELLAR DISKS
P M Cassen 415-965-5597

The objectives of this research are to obtain an understanding of the solar nebula and proto-stellar disks in general by analysis of theoretical models based on hydrodynamic and thermodynamic principles, and to relate these models to processes of planetary formation The optical and infrared appearance of proto-stellar accretion disks and circumstellar dust disks are studied and the results applied to observations of solar-type and other stars in young clusters Numerical experiments will be used to examine the stability of proto-stellar disks against gravitational condensation, and to explore the role of instabilities in disk evolution and planetary formation Results will be analyzed in the light of observations of the solar system and astronomical objects identified as proto-stars

W83-70299 **153-02-40**
Lyndon B Johnson Space Center, Houston, Tex
PLANETARY PETROLOGY
W C Phinney 713-483-3816

Physical and chemical constraints must be developed for the processes involved in the origin and evolution of the solid objects of the solar system Such constraints are necessary if meaningful models are to be developed for the evolution of specific objects The objectives of this research are to develop experimentally the values of necessary parameters that allow a quantitative understanding of the chemical and physical processes that produce observed planetary materials and to measure analytically the properties of natural occurrences that provide limits for the processes The development of the necessary data is accomplished by means of experimentation with both natural and synthetic materials under controlled conditions of temperature, pressure, oxidation-reduction, and composition Specific mineralogic compositions, textural relations, and phase assemblages can thus be related to specific sets of chemical and physical conditions that may occur on or within planetary bodies These conditions provide constraints that may occur on or within planetary bodies These conditions provide constraints for interpretations of planetary processes Petrologic, chemical, isotopic and tectonic data and models of the evolution of planetary crusts are developed with a strong basis in lunar and terrestrial data Major efforts will be devoted to searching for early terrestrial crustal units, studying materials from potential terrestrial analogs of early planetary crusts, and modeling crustal evolution

W83-70300 **153-02-70**
Jet Propulsion Laboratory, Pasadena, Calif
JPL PETROLOGY SUPPORT
A A Finnerty 213-354-4785

The objective of this task is to constrain theories of planetary formation and evolution by application of experimental petrology, phase equilibrium and thermodynamic theory, and to relate observable surface features to models for planetary interiors Experiments at pressures and temperatures representative of igneous and metamorphic rock-forming processes are conducted in two piston-cylinder devices at JPL, and in other facilities at other laboratories Experimental and theoretical data on phase equilibrium and thermodynamics are incorporated into models of petrologic and thermal state of planetary interiors Geothermometers and geobarometers are applied to terrestrial rocks, both to test their performance and to study petrologic and thermal state of the upper mantle of an accessible planet, Earth The tested 'thermobarometers' are then applied to selected examples of extraterrestrial rocks Certain surface features of planetary bodies, studied from spacecraft photography, are analyzed in terms of interior processes

W83-70301 **153-03-50**
Goddard Space Flight Center, Greenbelt, Md
CROSS SECTION DETERMINATION, COSMIC RAY INDUCED BACKGROUND DETERMINATION, NEUTRON TRANSPORT CALCULATION AND PLANETARY EVALUATION AND DYNAMIC STUDIES
J I Trombka 301-344-5941

The objective of this investigation is to obtain cross sections and to develop neutron and gamma-ray transport methods for predicting the magnitude and spectral distribution of cosmic-ray and neutron induced gamma-ray emission from cometary, planetary and asteroid bodies Similar calculations are required to predict the background produced in detector materials by cosmic-ray primaries and secondaries Studies of the evaluation and dynamics of planetary bodies using the data obtained during such flight missions as Apollo, Viking, Luna, and Venera will be carried out A major problem in the interpretation of gamma-ray spectroscopic data with respect to chemical analysis of planetary bodies is the lack of information on cross sections and discrete line gamma-ray emissions from certain key elements (e g C, O and H) Both theoretical and experimental studies will be used to obtain this information Furthermore with the improved cross sections and spectral data, neutron annd gamma-ray transport calculations will be carried out to better understand the expected gamma-ray emission from planetary asteroids and cometary surfaces as a function of hydrogen and macroscopic cross section Correction factors for changes in the fast to thermal ratio and flux depressions will be derived

W83-70302 **153-06-40**
Lyndon B Johnson Space Center, Houston, Tex
MANNED LUNAR BASE STUDY
W W Mendell 713-483-3816

Definition of rationale and objectives for a lunar base is necessary in order to properly plan technological and scientific analysis required for future programmatic decisions An in-house review of previous lunar base studies will be carried out and provided to a distinguished group of science and technology experts, who will assist in preparing a baseline rationale and plan

W83-70303 **153-07-40**
Lyndon B Johnson Space Center, Houston, Tex
REMOTE SENSING
W C Phinney 713-483-3816

The objective of this research is to optimize the ability to interpret and utilize remotely sensed data from planetary surfaces A laboratory program based on infrared interferometry of particulate materials will define the spectral radiative transfer regime in planetary surfaces The results, when used with remotely sensed observations, will yield data which can be interpreted in terms of the experimental work and which can be compared to results from other techniques

W83-70304 **153-08-40**
Lyndon B Johnson Space Center, Houston, Tex
EXPERIMENTAL IMPACT CRATERING
W C Phinney 713-483-3816

The objectives of this task are to develop a better understanding of planetary scale impact cratering and asteroid disruption processes, the mechanisms associated with them, and the results of these processes under various conditions Data from experimental impacts carried out with the vertical impact facility will be collected through measurements of the targets after impact and through use of a high-speed (400 frames/sec) camera currently being installed Specific studies will investigate the role of target curvature, size, and mass on cratering and disruption style, and will utilize the refrigerated target chamber in comparing impacts into various H2O ice-rich targets to more familiar rock-like targets

W83-70305 **153-08-50**
Goddard Space Flight Center, Greenbelt, Md
EXPERIMENTAL MAGNETISM
P J Wasilewski 301-344-8317

An experimental magnetism program will be conducted to provide (1) a characterization of meteoritic tetrataenite and explanation of its role in the magnetization of meteorites, (2) a consolidation of meteorite magnetization data and publication of a review of this data pointing to statements regarding what phases carrying primary remanence, and when the remanence was acquired during the history of the meteorite, and (3) an understanding of thermal demagnetization of shock induced magnetization in Cu(Fe) alloys The experimental research effort will concentrate on the study of the new mineral tetrataenite which forms via atomic ordering, at temperatures < 300 C, and the use of the gas gun to shock impact the Cu(Fe) alloys and thermally demagnetize the resulting remanence In addition a review will be produced, which will be a state of the art comment on meteorite magnetism These results and any published results will be considered

W83-70306 **153-09-40**
Lyndon B Johnson Space Center, Houston, Tex
EARLY CRUSTAL GENESIS
W C Phinney 713-483-3816

Physical and chemical constraints must be developed for the processes involved in the origin and evolution of the solid objects of the solar system Such constraints are necessary if meaningful models are to be developed for evolution of specific objects Petrologic, chemical, isotopic and tectonic studies and models of the evolution of planetary crusts are underway with a strong basis in lunar and terrestrial data Major efforts will be devoted to studying samples that are related to

the early formed crusts, searching for early terrestrial crustal units, studying materials from potential terrestrial analogs of early planetary crusts, and modeling crustal evolution

W83-70307 **153-10-40**
Lyndon B Johnson Space Center, Houston, Tex
JSC GENERAL OPERATIONS - GEOPHYSICS & GEOCHEMISTRY
M B Duke 713-483-4464

General operations support a variety of institutional and scientific support tasks at JSC that are considered essential for the conduct of research and for implementation of the planetary geophysics and geochemistry program Center support services such as printing, computer, photographic, and graphics are provided to the Lunar and Planetary Institute through a procedural agreement In-house support provides for co-sponsored of conferences, laboratory costs required by visiting scientists using existing facilities, and for costs required to operate common laboratory facilities and to provide for support services from other center elements

Planetary Atmospheres R&A

W83-70308 **154-10-80**
Ames Research Center, Moffett Field, Calif
PLANETARY ATMOSPHERIC COMPOSITION, STRUCTURE, AND HISTORY
J B Pollack 415-965-5530

Theoretical modeling and spacecraft data interpretation are used to determine the properties and physical processes characteristic of planetary atmospheres These properties include their temperature structure, aerosols, cloud layers, gaseous constituents, and opacity sources Emphasis is placed on reducing and analyzing data returned from spacecraft missions, such as Pionner Venus and Voyager or preparing for data expected from future spacecraft missions, such as Galileo However, use is also made of relevant ground based observations In addition, the origin and evolution of planetary atmospheres are studied by constructing models that are constrained by relevant spacecraft and groundbased data

W83-70309 **154-20-80**
Ames Research Center, Moffett Field, Calif
DYNAMICS OF PLANETARY ATMOSPHERES
R E Young 415-965-5515

The dynamics of the atmospheres of Venus and Mars are being studied using multidimensional circulation models The coupled nonlinear momentum and energy equations are solved numerically using combinations of finite difference and spectral methods The principal goals are to compare model results with spacecraft data and attempt to understand the dynamical effects of varying planetary rotation rate, solar energy deposition, infrared opacity, atmospheric mass and composition

W83-70310 **154-20-80**
Goddard Space Flight Center, Greenbelt, Md
DYNAMICS OF PLANETARY ATMOSPHERES
J A Pirraglia 301-344-6783

The objective is to apply geophysical fluid dynamics to planetary atmospheres in general and to study similar dynamical phenomena under different conditions The planets and their satellites present contrasts in mass, rotation rate, radiative time constants, heat deposition, and topographic influence on their atmospheres These disparate atmospheres present an opportunity to apply theoretical models to a wide range of parameter space using the data obtained from planetary missions Atmospheric circulation is strongly affected by energy and momentum transport The relationship between the mean flow and waves that contribute to the transport processes will be investigated This will be accomplished by the development of a general spectral solution of the equations which describe the wave mean flow dynamics The generalized solution will be used to study the role of instabilities and forced waves in the transport of energy and momentum under the variable boundary conditions encountered on the planets

W83-70311 **154-30-80**
Ames Research Center, Moffett Field, Calif
PLANETARY CLOUDS, PARTICULATES AND ICES
O B Toon 415-965-5971
(147-30-02, 154-10-80, 146-10-04)

A microphysical model of the Titan aerosol was developed The model will be expanded to include condensational clouds Ionization profiles of the atmosphere will be developed so that the aerosol charge can be calculated The model will be used to simulate Titan's aerosol layer and to compare with observations A physical-chemical model of the Venus clouds was developed The model was used to interpret data obtained by Pioneer Venus probe instruments A dynamical model of radiative dynamic feedback was developed and applied to understand the albedo features observed on Venus A model of lightning generation on Venus was developed The Venus cloud model will be used to study clouds in convectively active regions Also Cl2 and S chemistry at the cloud top will be investigated Studies of the dynamics of the UV features will be done using a more sophisticated model A new model of Martian dust, water ice and CO2 snow will be developed and applied to study Martian particulate related phenomena These phenomena include dust removal mechanisms, and the water vapor transport cycle The Mars related work represents a change in scope from prior activity under this RTOP

W83-70312 **154-40-80**
Jet Propulsion Laboratory, Pasadena, Calif
REMOTE SENSING OF ATMOSPHERIC STRUCTURE
G S Orton 213-354-2183
(154-10-80, 889-56-47)

The objective of this research is the development of accurate numerical approaches for the interpretation of infrared remote sensing data obtained under realistic conditions, in the presence of anticipated measurement noise as well as in the presence of clouds and aerosols Five important problems will be addressed (1) determination of atmospheric temperature profiles in the presence of clouds and aerosols when cloud cover is uniform or when temperature and cloud variations are highly correlated, (2) determination of both macro- and microphysical cloud properties, (3) determination of temperature in the presence of strong positive temperature gradients, (4) determination of gaseous abundance profiles in the presence of clouds, and (5) assembly of requisite molecular spectroscopic data for the application of these techniques in the outer solar system The approach will use a relaxation technique developed by Chahine, coupled with accurate and efficient radiative transfer algorithms, together with a simultaneous theoretical approach to these problems Testing of these techniques will be done using numerical simulations of data, comparing the conditions of the generating model with those retrieved by the technique The model test environments of significance in the near term will be the outer planets and Mars, in support of Voyager and Galileo data analysis and future mission experiment planning

W83-70313 **154-50-80**
Goddard Space Flight Center, Greenbelt, Md
ATOMIC AND MOLECULAR PROPERTIES OF PLANETARY ATMOSPHERIC CONSTITUENTS
John J Hillman 301-344-7974
(196-41-54 147-10-01, 188-41-55)

The principal goal of this laboratory spectroscopy program is to develop an organized body of knowledge of the molecular properties of planetary atmospheric constituents In the case of lower resolution planetary observations, such as Voyager infrared interferometer spectrometer (IRIS) (4/cm), identifications and abundance determinations require laboratory spectra of similar resolution which can be directly compared with the observations The highest possible spectra resolution is required when single features apparent in medium or high resolution Fourier transform (FTS) spectra are compared of more than one molecular transition, and the parameters (1) frequency, (2) strength, (3) lower state energy, and (4) foreign-broadening must be known for each as input in modeling the atmosphere For infrared heterodyne observations the need for ultra-high resolution laboratory data is especially critical, since the bandwidths accessible to these receivers are narrow and Doppler line profiles are completely resolved in the observed spectra A combination of tuneable diode laser (TDL) and FTS laboratory spectra can supply a complete set of line parameters anywhere in the infrared In this program TDL and FTS spectrometers will be applied to selected vibration-rotation bands of planetary molecular species Tasks include analyses of new molecules identified by Voyager IRIS in Titan and Saturn, line strength determinations in Nu4 of (12)CH4 and (13)CH4, analysis of Nu9, H2O2, analysis of Nu9, C2H6, obtaining Nu2 broadening parameters for H2

W83-70314 **154-60-80**
Goddard Space Flight Center, Greenbelt, Md
PLANETARY AERONOMY: THEORY AND ANALYSIS
R E Hartle 301-344-8234

The basic objective is to study the observed properties of the neutral atmospheres and ionospheres of the planets and their satellites, including earth, in order to identify and interpret the physical and chemical processes governing their behavior, encompassing solar planetary relationships The motivating philosophy here is that the study of processes occurring in the atmospheres and ionospheres of the planets and their

satellites provides important insights into the nature of similar processes operative in the earth's atmosphere and ionosphere under different parametric conditions and vice versa The investigations are pursued by analyzing and interpreting experimental data derived largely from flight programs after funding from project offices has terminated The data is used to determine the various chemical, compositional, dynamical and energetic states of the respective atmospheres and ionospheres, including the transport and deposition of mass, momentum and energy in these regimes In general, the approach involves the development of empirical descriptions of either global or small scale phenomena using data sets from a variety of spacecraft These empirical descriptions of the atmosperes and ionospheres are subsequently interpreted using theoretical models developed to reduce the physical and chemical processes involved Some of the specific phenomena addressed in this investigation include atmospheric and ionospheric motions on Venus, Jupiter and earth, interactions of solar wind and/or magnetosphere with atmospheres of Venus, Titan, and Earth, including modification of transport coefficients by plasma instabilities, solar planetary relationships, comparative planetary atmospheres, etc

W83-70315 **154-75-80**
Goddard Space Flight Center, Greenbelt, Md
COSMIC CHEMISTRY AERONOMY, COMETS, GRAINS
B Donn 301-344-6859

This RTOP studies physiochemical phenomena in planetary atmospheres, comets, and related aspects of interstellar matter Laser spectroscopy, photochemistry, reaction kinetics, and condensation processes are investigated and properties of atoms, radicals, molecules and grains are measured These experimental results are used to interpret astronomical observations and develop theoretical models Flash photolysis-resonance fluorescence apparatus with computer interface for real time analysis yields absolute atom-molecule rate constants A CW tunable dye laser is used for radical detections Mass spectrometry may be added to the discharge flow system An excimer laser, alone or combined with a flashlamp, is used for sequential photodissociation studies of planetary or cometary radicals A tunable dye laser is used to detect and study the properties of these radicals Gas phase and matrix isolation condensation are used to simulate production of primordial solar system, cometary or interstellar grains and study mechanism of production Particle accelerator irradiated ice mixtures are used to study cosmic ray effects on comets Experiments to determine vaporization process for ice mixtures are planned using the method currently under study

W83-70316 **154-80-80**
Goddard Space Flight Center, Greenbelt, Md
EXTENDED ATMOSPHERES
H A Taylor, Jr 301-344-6610

The objective of the RTOP is to advance the understanding of comparative solar planetary relationships Global characteristics of ionosphere neutral atmosphere variations are studied, as indicators of energy coupling processes regulating the upper atmosphere in the region extending from the exobase to the ionopause By examining the behavior of the ionic constituents at lower altitudes near the exobase and at higher altitudes approaching the ionopause, insight is obtained with respect to collision dominated as well as collisionless processes Studies of Venus will examine longer term effects, such as the basic planetary atmosphere evolution, as well as short term effects such as the ion and neutral response to variations in solar radiation and in the solar wind The approach involves the analysis of global sets of satellite data describing the composition, structure, and energetic states of the planetary atmosphere-ionosphere system These descriptions include large scale results in the form of empirical models as well as phenomenological data sets descriptive of uniquely varying conditions or events Results of the empirical studies are assessed in terms of current theoretical models Comparison of models results for constrasting planetary conditions, e g , Earth and Venus, are performed to test basic physical concepts Program support to the Planetary Programs Office is also provided under this RTOP

W83-70317 **154-80-80**
Jet Propulsion Laboratory, Pasadena, Calif
EXTENDED ATMOSPHERES
R S Wolff 213-354-5073

To characterize the dayside Venus ionopause and to determine whether or not various classes of ionopause structures exist, and whether or not each such structure is stable against flow driven instabilities, Pioneer Venus Fields and Particles data from several instruments will be studied Similarly, MHD discontinuities inside the Venus ionosphere will be searched for using PVO magnetometer, ion mass spectrometer, retarding potential analyzer, and electric field data The dynamical response of the Benus ionosphere to changing solar wind conditions will be simulated using the 1-dimensional hydrodynamic code developed by Wolff and Stein (1982) Horizontal magnetic fields and the effects of neutral molecules on the energy and momentum transport in the ionosphere will be examined by including appropriate terms in the momentum and energy equations of the code The nature of the cometary nucleus and the ejected dust are investigated by techniques that combine a dynamical approach with photometric considerations The aim is to interpret a broad range of dust phenomena in the coma and tail, to assess the degree of heterogeneity of the nucleus surface, and to determine the rotational constants of comets Towards these objectives, a study of the surface morphology of Comet Halley will continue, and to this end high resolution photographs from the comet's 1910 apparition are being collected, digitized, and image processes at the present time, in collaboration with Mr S M Larson at the U of Arizona In addition, a study of dust particle fragmentation in Comet Markos 1957 V will be performed (in collaboration with J A Farrell at Los Alamos National Laboratory), outgassing asymmetry for short period comets will be investigated, and work will continue on split comets

Halleys Comet Watch/Experiments

W83-70318 **156-02-02**
Jet Propulsion Laboratory, Pasadena, Calif
INTERNATIONAL HALLEY WATCH
R L Newburn, Jr 213-354-2319

The International Halley Watch has been designed to maximize the scientific value of ground-based observations of Halley's Comet Important in their own right, such observations will also enhance the value of space observations, setting the brief duration flyby data in the context of the overall apparition, placing the extremely high resolution encounter data into the normal scale of observations, and filling in missing wavelengths Its goals are to standardize observing techniques wherever useful and possible, to coordinate the observing, and to collect and publish all data in a comprehensive Halley Archive The IHW is designed to avoid the problems of 1910 where the two major monographs on Halley were not published until 21 and 24 years later and where much data remains unpublished to this day Individual nets of observers worldwide will be organized for each observing technique by Discipline Specialists selected by means of competitive proposals The proposals were reviewed by a Steering Group of international scientists who also advise on overall IHW operations Overall IHW coordination and Archive publication is the responsibility of a Lead Center Organization Cooperation with flight projects will be achieved through Project Representatives appointed by the projects and through mutual participation in the Steering Groups of the IHW and the Inter-Agency Committee on cooperation in flights to Halley Amateur efforts are to be coordinated by a scientist at the Lead Center working through existing amateur organizations and a small group of special consultants on such activities

W83-70319 **156-03-01**
Jet Propulsion Laboratory, Pasadena, Calif
GIOTTO HALLEY MODELING
R L Newburn 213-354-2319

The primary objective of this task is creation of detailed, quantitative, environmental models of Halley's Comet to aid in proper design of a spacecraft and of spacecraft instruments Models of Halley's Comet are prepared by creating theories adequate for quantitative description of recent comets for which modern, quantitative observations exist and then applying them to Halley, scaling them to the Halley light curve and such other semiquantitative data as exist Old plate files of the 1910 apparition are being searched for information on the rotation period and surface structure of Halley as reflected in its jet activity Other needed parameters are being obtained by analogy from observations of recent comets

W83-70320 **156-03-02**
Jet Propulsion Laboratory, Pasadena, Calif
GIOTTO EPHEMERIS SUPPORT
D K Yeomans 213-354-2127

The objectives under this task are to provide the European Space Operations Centre (ESOC) with information, analysis, and documented software that will allow them to independently update the orbit and ephemeris of comet Halley in 1985-1986 The results of this task will be used at ESOC for operational support of the Giotto flight project The operational ephemeris software will be built from existing research software Modifications will be made to make the software state-of-the-art and compatible with existing ESOC hardware An effort will also be made to improve upon the existing, but imperfect, nongravitational force model for comet Halley's motion The export software and nongravitational

force model will be completely tested, checked, and documented before being turned over to ESOC personnel

W83-70321 **156-03-03**
Jet Propulsion Laboratory, Pasadena, Calif
GIOTTO ION MASS SPECTROMETER CO-INVESTIGATOR SUPPORT
M Neugebauer 213-354-2005

The ion mass spectrometer to be flown on the Giotto mission is based, in part, on a high energy range spectrometer developed at JPL The objectives of this task are to (1) optimize the design of this instrument for use on Giotto, (2) generate an end-to-end computer simulation of the trajectories of ions through the instrument, (3) perform experimental checks of the optical design, and (4) support the Principal Investigator of this experiment as required The approach involves both computer simulation of the instrument and construction and testing of critical elements at the breadboard level Frequent contact between all team members is maintained to coordinate interfaces and requirements This task also involves the generation of required documents, support of instrument calibration, development of data-reduction algorithms, evaluation of instrument performance, analysis of flight data, and submission of reduced data to the National Space Science Data Center

W83-70322 **156-03-04**
Jet Propulsion Laboratory, Pasadena, Calif
GIOTTO PARTICULATE IMPACT ANALYZER (PIA) CO-INVESTIGATOR SUPPORT
Z Sekanina 213-354-7589

There are three primary objectives under this task The first is the theoretical support for the PIA experiment (Sekanina, Zook), which includes the study of the dust environment of Comet Halley, the formulation of dust models, and the structure the surface layer of the comet's nucleus The second objective is the laboratory support for the experiment (Clark, Utterback), which includes the preparation of test projectile particles, the provision of test results and circuit design information related to the impact light-flash subsystem and the high speed ion sensor subsystem, and the assistance in developing and applying a laser blow-off ion source for particle impact simulation in flight readiness tests The third objective is the participation in the flight data reduction and interpretation (all co-investigators), which includes the conclusions on the particle composition, mineralogy, dust production, particle mass distribution, and nucleus structure and evolution

W83-70323 **156-03-07**
Jet Propulsion Laboratory, Pasadena, Calif
GIOTTO DUST IMPACT DETECTION SYSTEM (DIDSY)
Z Sekanina 213-354-7589
(156-03-07)

This RTOP covers two objectives (1) theoretical study of the dust environment of Comet Halley, based on 1910 data from Halley and recent data from other comets, prior to the Giotto encounter, in order to assist the dust impact detection system (DIDSY) team in experiment definition, flight strategy and data interpretation, (2) participation in the analysis and interpretation of the DIDSY data after encounter, with emphasis on the particle mass distribution, spatial distribution, dust production rate, and relation to the large body of optical and infrared remoe sensing data Models of the dust flux, mass (size) distribution, and potential temporal and spatial variation for Halley's comet will be developed, based on observed structure in the coma of Halley's Comet in 1910, the orientation of the dust tail, and analysis of the dust thermal emission and optical scattering in recent comets expected to be similar to Halley The co-investigator will participate in the analysis of the DIDSY data, with emphasis on the mass distribution, spatial and temporal variations, and the relation between the in situ DIDSY measurements and remote sensing optical and infrared data

Planetary Instrument Definition

W83-70324 **157-03-50**
Goddard Space Flight Center, Greenbelt, Md
X-RAY, GAMMA-RAY AND NEUTRON/GAMMA-RAY METHODS FOR PLANETARY EXPLORATION
J I Trombka 301-344-5941

The objective of this investigation is to develop remote sensing and in-situ measurement system for geochemical and geophysical exploration of the planets, asteroids and comets The remote sensing X-ray spectrometer study will consider proportional, solid state detectors, and imaging systems Elemental composition for elements with atomic numbers greater than Z=6 (carbon) using solar X-ray fluorescent spectral measurements are being considered Both theoretical and experimental studies will be used in the investigative program Both gamma-ray and X-ray detector systems are significantly affected by the space radiation environment Both induced backgrounds and radiation damage in gamma ray detectors (i e NaI(T1), CsI(Na), Ge(Li) and Ge (high purity)) have been studied and methods for predicting the magnitude of these effects are under development These studies will be confirmed There is not a great deal of information available on the effects of the space radiation enviroment on X-ray detectors Such studies will be started Balloon flights of remote sensing gamma-ray and X-ray spectrometer systems will be flown in order to ascertain their sensitivities and the magnitude of the space environment induced activity

W83-70325 **157-04-80**
Jet Propulsion Laboratory, Pasadena, Calif
INFRARED EXPERIMENT DEVELOPMENT
D J McCleese 213-354-2317
(154-90-80)

The objective of this task is the development of advanced infrared instrumentation for NASA's program of planetary exploration from spacecraft The emphasis is on the following atmospheric science goals (1) determine the thermal structure and its spatial and temporal variability in the terrestrial and outer planets, (2) map the abundance and vertical, lateral and temporal variability of key atmospheric species, (3) measure, by direct and indirect means, atmospheric motion, and (4) determine the physical properties of clouds and aerosols The investigation of surface phenomena is also of fundamental importance in the rational development of infrared instrumentation In particular one objective is the application of infrared remote sensing to the identification of surface materials, determination of surface cooling rates, thermal inertia measurements and the mapping of surface morphology The approach will be to develop in the laboratory the critical hardware for an advanced infrared sounder This developmental instrument is both versatile in the science goals which it can address and is sufficiently flexible to permit its use in future terrestrial and outer planet flight opportunities

W83-70326 **157-04-80**
Goddard Space Flight Center, Greenbelt, Md
IMPROVEMENTS IN NEUTRAL AND ION MASS SPECTROMETRY
Keith W Ogilvie 301-344-5904

The study of the composition of the volatile components of comets requires sensitive ion and neutral mass spectrometers capable of operation in a dusty environment Because of the changing conditions the instruments are likely to encounter and the limited observation time spectrometers must be capable of multimode adaptive operation It is anticipated that a wide range of stable molecules as well as radical species will be encountered To effectively detect them requires ionization and separation techniques which preserve them with a minimum amount of fragmentation Recent measurements in the magnetospheres of Earth, Jupiter and Saturn have shown the importance of plasma composition measurements, and heavy ions have been detected in the vicinity of Mars It seems likely that further study of that planet will require that the composition of plasma in its neighborhood be measured However, some optimization of the properties of present instruments is required before their specifications fit those required to investigate the plasma regime of a planet with a small intrinsic magnetic moment and sparse atmosphere

W83-70327 **157-04-80**
Ames Research Center, Moffett Field, Calif
VEGA BALLOON NEPHELOMETER DESIGN
B Ragent 415-965-5514

The objective of this activity is to prepare a preliminary design for a nephelometer instrument to make in-situ measurements of the properties of the Venus clouds The instrument is to be carried on a balloon launched into the Venus atmosphere from the descent vehicle of the USSR VEGA mission The preliminary design is to be furnished to the Centre National d'Etudes Spatiales (CNES) of France for implementation into a flight instrument by CNES The flight instrument will be integrated by CNES into the balloon package to be delivered to the USSR by CNES for the December 1984 launch of the VEGA spacecraft Ames Research Center is to participate fully (1) in analyzing the data to be received from this instrument as well as correlative data from other instruments aboard the balloon, and (2) in publishing the results of this experiment as a full participant and co-author

W83-70328 **157-05-50**
Goddard Space Flight Center, Greenbelt, Md
PLANETARY INSTRUMENT DEVELOPMENT PROGRAM/ PLANETARY ASTRONOMY
M J Mumma 301-344-6994
(196-41-50, 188-41-55, 196-41-54)

This RTOP supports the development of components for advanced generation infrared spectrometers for planetary observations Task-02 addresses the development of compact, power efficient infrared heterodyne spectrometer components suitable for eventual space flight use Particular emphasis is placed on developing RF-excited waveguide CO2 lasers, passively cooled photomixers and pre-amplifiers, and integrated acousto-optic spectral line receivers Task-03 addresses development of a long travel, mangetically suspended, cryogenic carriage for the moving mirror of a Fourier transform spectrometer Following verification of the performance of the cryogenic carriage, a brass board interferometer will be assembled and tested to verify its suitability for future space flight use

W83-70329 **157-20-70**
Jet Propulsion Laboratory, Pasadena, Calif
PLANETARY INSTRUMENT DEFINITION
A A Finnerty 213-354-6057

This RTOP supports two tasks development of a miniaturized scanning electron microscope and particle analyzer (SEMPA) as a potential flight instrument for inclusion on any mission that samples a planetary body or cometary dust, and development of a gamma-ray spectroscopy remote sensing space experiment to determine concentration and distribution of naturally radioactive and cosmic ray excited isotopes for a variety of elements in the surfaces of solar-system bodies The SEMPA instrument was designed to obtain elemental analysis of particles as small as 0 25 microns and to image them with resolution of 0 04 microns A breadboard model was fabricated and is being tested to prove the concept The effort is presently concentrated on testing the electron optical performance, and the next stages are automation of the electron optical column, testing of redundant electron emitter configurations, and demonstration of X-ray analytical capabilities The advanced gamma-ray spectrometer utilizes a large high resolution Ge detector with sensitivity greatly superior to the Apollo instrument Scientific and engineering studies are aimed at evaluating the capabilities of the system and developing the long-lead technology subsystems needed to demonstrate feasibility These include thermal and mechanical testing of Ge detector assemblies, study of gamma-ray response characteristics, testing of the influence of heavy ion bombardment, evaluation of interfaces with radiative coolers and of possible incorporation with an X-ray spectrometer

Solar Terrestrial and Astrophysics ATD

W83-70330 **159-41-03**
Marshall Space Flight Center, Huntsville, Ala
ORBITING VLBI FEASIBILITY STUDY
S H Morgan, Jr 205-453-3430

The purpose of this RTOP is to aid in assessing the feasibility of extending the very long baseline interferometry (VLBI) technique into space by placing one of the receiving stations in Earth orbit The first step in an evolutionary sequence that would eventually lead to a mature free-flying VLBI observatory is to accommodate VLBI observations on the deployable antenna experiment (This experiment is an engineering test program to evaluate and demonstrate large antenna performance capabilities in space The concept, now under study through OSTS and DOD sponsorship, is to deploy a large antenna attached to the Shuttle cargo bay) This RTOP will assess the feasibility of accommodating VLBI observations on this experiment Results of this effort will be integrated into the deployable antenna experiment The scientific, functional and operational requirements for a Shuttle-attached deployable antenna to accommodate VLBI observations will be established in conjunction with interested scientists Using these requirements and results from the ongoing deployable antenna experiment studies, the feasibility of accommodating VLBI observations will be assessed

W83-70331 **159-46-01**
Marshall Space Flight Center, Huntsville, Ala
ADVANCED X-RAY ASTROPHYSICS FACILITY (AXAF)
C C Dailey 205-453-0162

The AXAF will be a Shuttle-launched and maintained X-ray observatory with a lifetime of about 15 years It will provide significant improvements over all previous research capabilities in X-ray astronomy by its long life, its high performance optics and its sophisticated instrumentation After completion of conceptual studies, parallel definitions study contracts will be issued to industry in a competition for the development program In-house and contracted supporting technology will continue to advance the readiness level in key areas A major example of technology development is the Technology Mirror Assembly Program involving two separate approaches to grinding and polishing GFE mirror blanks to AXAF performance goals The resulting mirror systems will undergo extensive evaluation in the MSFC X-Ray Test and Calibration Facility

Earth and Ocean Physics SR&T

W83-70332 **161-10-00**
Goddard Space Flight Center, Greenbelt, Md
OCEAN ADVANCED STUDIES
J T McGoogan 804-824-3411

The objectives are to (1) perform advanced studies of instrumentation and to assist in satellite mission definition as required to support future ocean program goals, (2) improve the quality of instrument measurements and accuracy of algorithms, while reducing the power, data load and cost where feasible to enhance the probability of flight opportunity, and (3) develop the hardware required to accomplish these goals A long range plan will be developed and system studies, instrument design, modeling, simulations, laboratory tests, aircraft experiments and error assessments will be performed to assess various approaches for implementation of measurement systems A plan for a Shuttle ocean instrumentation experiment will be developed Orbit determination techniques will be assessed New attitude tracking algorithms that are less susceptable to bias will be developed Experimental hardware will be developed for wave tank laboratory testing of radar reflectivity versus wind and wave conditions A total system design for implementing an ocean color imager on an advanced Tiros-N satellite will be developed including definitive costs and schedule to support a new initiative for FY-84 Scatt accommodation studies on the most probable spacecraft will be accomplished Instrument specifications to meet SWG requirements will be developed Basic backscatter studies, experiments, algorithm evaluations and over all-to-end system plans will be developed

W83-70333 **161-10-01**
Jet Propulsion Laboratory, Pasadena, Calif
RESEARCH MISSION STUDY - TOPEX
C A Yamarone 213-354-7141

A total observational system for the measurement and monitoring of global ocean circulation will be defined through the use of an Earth orbiting system capable of providing dedicated high resolution altimetric measurements of dynamic ocean surface topography Specifically, the study will include (1) the preliminary configuration of the mission including precision orbit determination capabilities, (2) the preliminary configuration of all elements of TOPEX including sensor configuration by the appropriate implementing center, (3) the preliminary definition of the interface requirements and integration activities of the major TOPEX elements, (4) the development of a management plan, procurement strategy, and implementation schedule, and (5) the development of detailed cost information Science and mission requirements were developed in FY-80 and finalized in FY-81 Mission and satellite concepts were assessed in FY-81 and lower cost mission and systems assessed in FY-82 The approach for FY-83 will be to refine the configuration of all elements of the observational system, perform limited development of critical sensors, pursue further analysis and definition of precision orbit definition system and pursue further avenues of cost reduction

W83-70334 **161-10-03**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED EARTH ORBITER RADIO METRIC TECHNOLOGY DEVELOPMENT
W G Melbourne 213-354-5071
(161-20-01)

Late in 1980 it was recognized that subdecimeter orbit determination required by future application missions such as TOPEX cannot be provided by laser tracking without tailoring the spacecraft design to minimize drag effects and considerable expansion of the number of laser tracking sites Both of these requirements are significant cost drivers This RTOP was initiated in FY-81 to rectify this situation by investigating and developing a radio metric tracking system that can provide an order of magnitude improvement in current low Earth Satellite orbit determination capabilities without prohibitive spacecraft or ground system requirements The need for such an advanced tracking system has been increased with the addition of the scatterometer option to the TOPEX spacecraft with the attendant lowering of the orbit altitude and an increase area to mass ratio of the satellite Recently with the effort to minimize the dependency of TOPEX on GRAVSAT, this advanced radio metric tracking system has taken on the additional task of providing data which can be used to substantially improve the geoid for wavelengths of 1000 km and longer The first year of this RTOP was spent performing preliminary accuracy and cost analysis studies for several candidate tracking systems Early in the second year the RTOP tem recommended placing the analysis, design and demonstration emphasis

on a tracking system composed of the 18 GPS Navstar satellites and GPS receivers at approximately a dozen unattended ground stations and on the TOPEX spacecraft This system, called SERIES-X, appears to be feasible, economical, and has the potential of giving at least an order of magnitude improvement over existing systems Since this system involves new technology, a feasibility demonstration will be carried out under this RTOP

W83-70335 **161-20-00**
Goddard Space Flight Center, Greenbelt, Md
PHYSICAL OCEANOGRAPHY
D B Rao 301-344-4713

The objective is to conduct a variety of oceanic research activities which are important to the agency's physical oceanography program and will contribute to particulate aspects of the program as they evolve Among these activities are studies involving the calculation of oceanic tides, upper ocean dynamics and thermodynamics, North Atlantic mesoscale features, remote sensing of ocean circulation, microwave radar oceanography, microscale ocean surface dynamics, ocean circulation and topography, advanced location and data collection systems, a surface contour radar for ocean wave studies, and research applications of ocean data in large-scale forecasting models Approaches to the variety of problems include the application of Goddard modeling and sensors and system development capabilities The RTOP supports the Oceans Program and the end objectives of understanding, predicting and managing the environment

W83-70336 **161-20-07**
Jet Propulsion Laboratory, Pasadena, Calif
ALTIMETER TIME-DEPENDENT CURRENT STUDIES
M E Parke 213-354-2739

The objective of this work is to investigate two-dimensional mapping of time varying ocean topography, and to apply the results to some areas of known geophysical signal where some ground truth is available The approach is to estimate the orbit error via a small area crossing arc program These results extend naturally to an estimate of the time history of the orbit error for SEASAT mission When this estimate of the orbit error is removed from the altimeter data and the results binned allowing for the mean background gradient, a mean sea surface is produced A map of residual variability can also be produced The altimeter data with the orbit error estimate removed will be used to investigate the spin-up of the Somalia eddy under the monsoon wind, and to investigate the correlation of the height variability in the Antarctic Circumpolar Current with variations in the zonally averaged wind speed

W83-70337 **161-20-10**
Jet Propulsion Laboratory, Pasadena, Calif
GULF OF MEXICO CIRCULATION STUDIES
G H Born 213-354-4644
(161-10-01, 161-20-12)

The objective of this research is to study the use of satellite altimetry and scatterometer wind data with in situ data for the description of ocean circulation in the Gulf of Mexico In particular, data from the SEASAT altimeter and scatterometer, as well as in situ data, will be used to provide boundary conditions for a numerical circulation model of the Gulf This research will answer fundamental questions regarding techniques for the assimilation of satellite and in situ data into circulation models, the effects of error in this data on the circulation model, and what new information on the circulation in the Gulf of Mexico can be gleamed from the combined use of satellite and in situ data with numerical models

W83-70338 **161-20-11**
Jet Propulsion Laboratory, Pasadena, Calif
TIME DEPENDENT FIELDS
D B Chelton 213-354-7151

There are two primary objectives of this project The first is to evaluate the scientific usefulness of satellite wind estimates by determining the accuracy with which they measure wind speed and direction In part, this involves comparison of the satellite estimates with conventional in situ measurements from ships and buoys Another approach being used to satisfy this first objective is the intercomparison of global maps of wind speed measurements averaged over weekly and monthly time intervals by all three satellite wind sensors (altimeter, scatterometer and scanning multichannel microwave radiometer) The second objective is the eventual incorporation of satellite wind measurements in statistical studies of the large-scale dynamics of wind-driven ocean circulation The approach to be used in accomplishing this objective is to use conventional hydrographic measurements from ships and sea surface elevation measurements from the SEASAT and GEOS-3 satellite altimeters to quantify the near-surface ocean circulation These parameterizations of the ocean circulation can then be statistically related to the satellite wind measurements using standard analysis techniques

W83-70339 **161-30-00**
Goddard Space Flight Center, Greenbelt, Md
OCEAN OPTICS
D B Rao 301-344-4718

The objective is to conduct a variety of ocean optics research and development activities which are important to the agency's oceanography program and will contribute to particular aspects of the program as they evolve Among these activities are studies involving the refinement of the SMMR ocean algorithm, coastal and estuarine dynamics processes research, CID color scanner development, applications of laser techniques, and a comparative study of ocean upwelling regimes using visible and IR imagery Approaches to the variety of problems include the application of Goddard algorithm sensor, and system development capabilities, the conducting of experiments, and the analysis of satellite and aircraft data The RTOP supports the Oceans Program and the end objectives of understanding, predicting and managing the environment

W83-70340 **161-30-01**
Jet Propulsion Laboratory, Pasadena, Calif
OCEAN APPLICATIONS DEVELOPMENT PROGRAM
D R Montgomery 213-354-2339

The Program objectives for FY-83 will focus on a scaled-down version of the fisheries applications task and the start of a pilot effort, in cooperation with the Canadian Ice Central, the NOAA-NWS and the Navy-Fleet Numerical Oceanography Center, to utilize Nimbus-7 SMMR ice observations in support of commercial off-shore oil and gas operations, arctic transportation activities, NWS forecasts for Alaska mariners and Navy operations The fisheries applications task will phase down to a point of continuing level support of the CZCS data processing at Scripps Institution of Oceanography so that it continues to be accessible to NOAA-NWS and the fishing industry Elements of the application task involving tailored fisheries-aids products will be transferred to NOAA-NWS and/or the private sector A final evaluation report will be prepared with the results of all previous work The Nimbus-7 SMMR ice pilot effort will involve the near real-time processing of the SMMR data at FNOC for user applications and in preparation of ice forecasts Both U S & Canadian participants will provide resources at no cost to either governments

W83-70341 **161-30-05**
Jet Propulsion Laboratory, Pasadena, Calif
LIDAR AND ACOUSTICS APPLICATIONS TO OCEAN PRODUCTIVITY
D J Collins 213-354-3473

The objective of this research is to develop in situ instrumentation capable of examining the vertical structure of the phytoplankton and zooplankton communities in the ocean to provide a detailed description of the three-dimensional structure of the ecological systems involved in ocean productivity These measurements form one part of a long-term effort to monitor the productivity of the world's oceans using oceanic LIDAR from aircraft and using satellite instrumentation to provide images on a global scale These objectives will be achieved by (1) development of an in situ LIDAR instrument capable of remote measurement of the fluorescence and spectral reflectance from chlorophyll and other pigments This unit will use the water Raman return as a measure of the optical properties of the water column, and will use Raman and Brillouin scattering for the remote measurement of temperature, (2) development of a linearly frequency modulated sonar instrument capable of measuring the vertical distribution of zooplankton species in the euphotic zone, and (3) development of a towed submersible that will provide a stable platform for the in situ instrumentation and that will provide physical oceanographic data and calibration data required for these measurements

W83-70342 **161-40-00**
Goddard Space Flight Center, Greenbelt, Md
POLAR OCEANOGRAPHY
D B Rao 301-344-4718

The objective is to conduct a variety of ice research activities which are important to the agency's program and will contribute to particular aspects of the program as they evolve Among these activities are studies on coupled models of oceans and ice, and involving mesoscale ice dynamics and processes observations, and Bering Sea marginal ice zone processes and remotely sensed observations, numerical modelling of sea ice dynamics and ice thickness, and studies of remote sensing of sea ice flow distribution and surface topography Approaches to the variety of problems include the applications of Goddard capabilities to the study of modeling and remote sensing problems, as well as the involving of leading researchers at institutions such as the Cold

Regions Research and Engineering Laboratory, the University of Washington, and the Polar Science Center The RTOP supports the Oceans, Ice and Climate Programs and the end objectives of understanding, predicting, and managing the environment Expected results include improved knowledge of coupled models of oceans and ice, mesoscale ice dynamics and processes, Bearing Sea marginal ice zone processes, sea ice dynamics and ice thickness, and sea ice flow distribution and surface topography

W83-70343 **161-40-02**
Jet Propulsion Laboratory, Pasadena, Calif
COUPLED ACTIVE-PASSIVE SEA ICE ANALYSIS
F D Carsey 213-354-8163

The objectives of this work are to develop and improve methods for extracting sea ice information from the SEASAT active and passive microwave data sets and from planned future satellite data sets, and to examine the behavior and distribution of the Arctic ice pack at the 1978 summer-fall transition using the SEASAT record The approaches used are (1) computer-aided feature tracking in SAR images to evaluate ice velocity and deformation measurement methods, (2) computer-aided feature classification of SAR images to develop ice type determination methods and to serve as validation for other sensor radiometric constant measurement, (3) examination of FIREX and other in-situ data and overlays of radiometer, scatterometer, and altimeter data on SAR images and on each other to determine responses of these sensors to ice type and open water fraction, and (4) region-wide analysis of radiance and backscatter to examine seasonal changes, observe overall behavior, and compare data sets from different instruments as though they were from different platforms

W83-70344 **161-50-00**
Goddard Space Flight Center, Greenbelt, Md
OCEANIC RESEARCH SUPPORT ACTIVITIES
D B Rao 301-344-4718

The objective is to provide support for a variety of oceanic and ice research activities which are important to the agency's program and will contribute to particular aspects of the program as they evolve Among these activities are studies of ocean circulation, water mass processes and eddies Approaches to the variety of problems include the application of Goddard capabilities to the study of modeling problems, as well as the involving of leading researchers at institutions such as the Woods Hole Oceanographic Institution, the Massachusetts Institute of Technology, Harvard University, and the Polar Science Center through a vigorous program of scientific seminars and cooperative research activities The RTOP supports the Oceans, Ice and Climate Programs and the end objectives of understanding, predicting, and managing the environment

W83-70345 **161-50-02**
Jet Propulsion Laboratory, Pasadena, Calif
OCEAN PROCESSES BRANCH SCIENTIFIC PROGRAM SUPPORT
M T Chahine 213-354-2433

The objective of this task is to support the NASA Oceanic Processes Branch in the development and use of remote sensing techniques to study physical and biological oceanic processes and their interactions with the atmosphere

Weather and Climate SR&T

W83-70346 **175-13-00**
Goddard Space Flight Center, Greenbelt, Md
SEVERE STORMS AND LOCAL WEATHER RESEARCH
J Simpson 301-344-6923

The objectives are to (1) utilize space observations to improve understanding, diagnosis, and predictability of severe atmospheric storms (tropical and mid-latitude) (2) develop analysis and interpretation techniques using data from satellites in combination with other sources, (3) adapt subsynoptic and storm scale numerical models to use satellite and conventional data, (4) simulate impact of satellite measurements on severe storm analyses, and predictions, (5) cooperate with NOAA and other user agencies on technology transfer and evaluation of new technology involving space observations, and (6) formulate requirements for future satellites to improve severe storm diagnosis, warnings Quantitative methods to utilize satellite data in predictive models, diagnostics, and nowcasting will be developed The scientific accuracy and usefulness of VAS geosynchronous soundings will be evaluated Case studies will be conducted utilizing AOIPS to synthesize data sets, often with model output, to improve physical understanding and predictive capability Combined satellite, remote aircraft, and in situ data sets will be obtained from participation in joint field programs numerical storm-scale, and subsynoptic scale models will be adapted to use satellite data in initialization, model improvement, and data interpretation

W83-70347 **175-20-00**
Marshall Space Flight Center, Huntsville, Ala
DEVELOPMENT OF NEW REMOTE DATA INTERPRETATION TECHNIQUES
W W Vaughan 205-453-3100

The objective of the research is to contribute to the NASA severe storms and local weather research program by conducting applied research and development activities using space-related techniques and observations that will increase the basic understanding of storms and local weather, thereby leading to improved accuracy and timeliness of local weather forecasts and severe weather warnings Utilizing the talents of university and private contractor groups, plus the MSFC in-house talents and laboratory capabilities, specific research activities as described in the tasks of this RTOP will be accomplished

W83-70348 **175-40-00**
Marshall Space Flight Center, Huntsville, Ala
REMOTE SENSOR DEVELOPMENT
W W Vaughan 205-453-3100

The objective is to contribute to the NASA severe storms and local weather research program by conducting applied research and development activities using space-related techniques and observations that will increase the basic understanding of storms and local weather, thereby leading to improved accuracy and timeliness of local weather forecasts and severe weather warnings Utilizing the talents of university and private contractor groups, plus the MSFC in-house talents and laboratory capabilities, specific research activities as described in the tasks of this RTOP will be accomplished

Pollution Monitoring SR&T

W83-70349 **176-10-00**
Goddard Space Flight Center, Greenbelt, Md
GLOBAL TROPOSPHERIC MODELS
R W Stewart 301-344-8895

The objectives of this RTOP are (1) to develop an understanding of tropospheric environmental problems that may be amenable to solution through the use of remotely sensed data, (2) assess the impact of urbanization and industrialization on global, regional, and urban air quality, and (3) develop, evaluate, and demonstrate remote sensing concepts for observing the nature and distribution of tropospheric pollution The approach will be to continue the development of global tropospheric models for calculation of tropospheric trace species concentrations, develop regional-scale models for study of heterogeneous processes in various tropospheric composition domains, improve the description of physical processes in one and two-dimensional models, and continue study of satellite methods of monitoring air pollution The research will lead to the (1) completion of a latitude dependent study of the seasonal variations of odd nitrogen in the troposphere, (2) extension of formulations of tropospheric box model to include description of rainout of all soluble species, and (3) development of a method for computing aerosol pollution flux from satellite and wind data

W83-70350 **176-10-00**
Goddard Space Flight Center, Greenbelt, Md
GLOBAL TROPOSPHERIC MODELING OF TRACE GAS DISTRIBUTION
David Rind 212-678-5589

The objectives are to make contributions toward understanding the global budgets of the primary trace species and man's potential impact on the trace gas abundances and determine measurement requirements and sampling strategies for the tropospheric air quality program The dimensional studies of trace gas distributions will be performed in cooperation with McElroy (Harvard University) A progressive series of studies of trace gases will be employed involving freons (source known, checks ability to model global transports including stratospheric/tropospheric exchange), methyl chloroform (source known, checks chemistry involving OH), and carbon monoxide (sensitive to OH, provides information on sources)

W83-70351 **176-30-01**
Jet Propulsion Laboratory, Pasadena, Calif
KINETIC STUDIES INVOLVING CH3O2, HO2 AND IO RADICALS OF TROPOSPHERIC IMPORTANCE
S P Sander 213-354-2625

A program of laboratory studies will be conducted to measure key

rate constants for reactions of hydroperoxyl (HO2), methylperoxy (CH3O2) and iodine oxide (IO) radicals The goal of this program is to improve and enlarge the kinetics database for reactions of tropospheric importance involving these radicals The experimental approach will be to utilize the techniques of flash photolysis, discharge flow-mass spectrometry and Fourier transform infrared spectroscopy

W83-70352 **176-40-03**
Jet Propulsion Laboratory, Pasadena, Calif
DEVELOPMENT OF RESONANT IONIZATION LASER SPECTROSCOPY FOR TROPOSPHERIC NOx MEASUREMENTS
J B Laudenslager 213-354-2259

The objectives of this work are to develop a sensitive and selective in-situ measurement technique, resonant ionization laser spectroscopy, for tropospheric NOx measurements, extend the measurement capabilities, in subsequent years, to other important tropospheric molecules, and make field measurements of tropospheric NOx from ground and aircraft platforms after confirmation of this technique from the preliminary laboratory studies The resonant ionization laser spectroscopy detection of NOx will first be demonstrated in the laboratory using commercial dye laser systems to identify laser wavelengths, pulse energies, and repetition rates required for field measurements of NOx in the parts-per-trillion range Computer simulations of the resonant ionization technique indicate that sensitivity for both NO and NO2 of a part-per-trillion with small error limits is feasible The field measurements for NOx will require compact, tunable, high pulse energy ultraviolet laser sources at selected wavelength regions It is planned to develop tunable ultraviolet excimer lasers for this application, and this excimer laser construction will be co-funded by an OAST-supported program for laser development The successful development of the resonant ionization laser spectroscopy detection method for tropospheric species will enable concentration measurements of several chemically coupled trace species to be made simultaneously with potentially smaller error limits than have been possible with other measurement techniques Simultaneous measurement of NO, NO2, O3, OH and jNO2 are particularly important for tropospheric chemical models to characterize the sources and sinks of tropospheric ozone

Space Processing Applied Research and Data Analysis

W83-70353 **179-11-20**
Jet Propulsion Laboratory, Pasadena, Calif
GLASS RESEARCH
George F Neilson 213-354-6365

The overall objective of this RTOP is to obtain both fundamental and practical information pertaining to the preparation and processing of glasses in a space environment These studies will establish a quantitative scientific basis for containerless experiments with glass forming materials The work in FY-83 will continue our studies with gel-derived glasses and of glass nucleation and crystallization behavior, and it will reinitiate a study of bubble behavior The objectives for FY-83 are to (1) determine the variation in properties of sodium borosilicate gels and glasses derived therefrom as functions of gel preparation and drying procedures, (2) conduct detailed crystal nucleation studies in several glass systems, and (3) study bubble dissolution (growth) in glass melts with and without the use of refining agents in systems containing a single gas bubble The activities under (1) will include the structural analysis of both the gels and gel derived glasses employed IR spectroscopy, X-ray powder diffraction and small angle X-ray scattering, as well as a study of the phase separation process in the glasses Under (2) a detailed study of the mechanism of internal and surface crystal nucleation in lithium diborate glass will be made, as well as a study of crystallization and the crystal nucleation mechanism in sodium disilicate glass Under (3) theoretical and experimental studies will be performed and compared Experiments will consist of the measurement of the radius of a bubble in a glass melt as a function of time Calculations will be made using theoretical models formulated previously Also, extensions of preliminary theoretical developments on bubble dissolution (growth) in chemically reactive systems will be given

W83-70354 **179-13-72**
Lyndon B Johnson Space Center, Houston, Tex
BIOPROCESSING STUDIES
Dennis R Morrison 713-483-5281
(179-13-62)

The objectives of this effort are to provide biological expertise (cell handling, cell culture, cell separation and bioassays) and to perform flight experiments in support of the materials processing in space program The JSC Bioprocessing Laboratory will coordinate the tissue culture, bioassays and cell characterization phases of projects with MSFC, university based investigators, and NASA Hqs Emphasis is currently placed on cell culture and ground based cell separation techniques Procedures to achieve maximum cell viability and growth before and after electrophoretic separations and assays for cell products will be developed The limitations of ground based cell culture will be evaluated and the advantages of culturing mammalian cells under weightless conditions will be identified The JSC Bioprocessing Laboratory is staffed with 4 civil service and 4 contractor professionals (including 3 Ph D 's and 2 M S 's) with experience in cell molecular biology, microbiology, cell culture technology, and aerospace systems engineering A National Research Council post-doctoral associate is also a member of the laboratory group The JSC biological space processing group will coordinate their efforts with the MSFC bioprocessing activity and will support the Separation Processes Branch (MSFC) in (1) development of separation technology, (2) development and construction of hardware for separations, (3) integration of space processing hardware, (4) mission control and payload operations, and (5) launch site operations

W83-70355 **179-15-20**
Jet Propulsion Laboratory, Pasadena, Calif
MULTIMODE ACOUSTIC RESEARCH
Martin Barmatz 213-354-3088
(179-13-20, 170-50-20)

This RTOP will provide fundamental research support for the advanced containerless processing technology program New classes of acoustic levitation have been discovered at JPL in rectangular, cylindrical and spherical geometries that may be attained by the excitation of multidimensional acoustic modes (multimodes) These new levitation principles provide us with advanced alternative methods for positioning and manipulating molten materials, which may lead to rapid cooling, separation of levitation and rotation capabilities, and the selection of arbitrary axes of rotation The long term objectives of this RTOP are (1) to develop theoretical acoustic models of these levitation classes and (2) to provide experimental validation of these models using research levitation devices The FY-83 activities will continue to develop a more fundamental understanding of these acoustic multimode levitation properties The objectives for FY-83 are to (1) experimentally study multimode levitation in spherical and long cylindrical chambers, and (2) develop theoretical expressions for multimode acoustic forces and associated stable levitation positions in the presence of a temperature gradient As these new, versatile techniques are verified, they will be incorporated into the advanced containerless processing technology program

W83-70356 **179-20-55**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED CONTAINERLESS PROCESSING TECHNOLOGY
T G Wang 213-354-6331
(179-70-10, 179-20-56)

The long range objectives of this task are to (1) study and advance the science of contactless positioning and manipulation in a high temperature acoustic containerless processing chamber, (2) provide technical information to acoustics containerless experimental system (ACES) engineering team, (3) develop a set of high temperature ground based containerless facilities for precursor material processing experiments Under this RTOP, breadboards for high temperature containerless processing systems will be developed, the principles of operation will be studied, the performance will be characterized, the limitations identified, and the influences of the acoustic field on the samples established The subjects to be addressed in FY-83 are experimental and theoretical studies of (1) acoustic positioning and manipulation capabilities in a high temperature gradient environment (from 25 C to 900 C), (2) acoustic waveforms, harmonic contents, power transfer, sample transport and stability associated with a high temperature gradient system, (3) high temperature ground based levitation systems which will allow one to melt, process, and solidify samples without crucibles in the laboratory, (4) KC-135 and laboratory tests of various acoustic geometries which may have special applications in material processing in space program, and (5) provide technical information to ACES engineering team and establish the operation conditions for ACES

W83-70357 **179-20-56**
Jet Propulsion Laboratory, Pasadena, Calif
ELECTROSTATIC CONTAINERLESS PROCESSING TECHNOLOGY
D D Elleman 213-354-5182
(179-20-56, 179-20-57)

The long range objective of the Electrostatic Task is to develop the science and technology base that is required for contactless positioning and manipulation of high temperature materials using electrostatic and electrophoretic forces An electric field containerless processing module

(EFCPM) operating at room temperature will be demonstrated by the end of FY-83 The successful demonstration of the room temperature EFCPM and the results from the high temperature charge loss studies will lead to the design and development of a high temperature facility and flight models of the EFCPM This program will include both theoretical and experimental investigations as well as reduced gravity tests of the module on the KC-135 aircraft In conjunction with the electric field positioning science workshop group the definition of potential MPS flight experiments utilizing the EFCPM will be given the highest priority in FY-83 Near term objectives to be addressed in FY-83 include the continuation of the low gravity tests of the room temperature bulk electrostatic positioning module Both the single axis module and the three axis tetrahedral electrode module will be tested The present modules use CCD cameras for sampling position sensing During FY-83 a capacitance sensing technique will be tested The capacitance method has several advantages over the optical method (1) at high temperatures the capacitance measurement will not require a window with the subsequent thermal problems associated with windows, (2) at very high temperatures sample definition can become poor in the optical method since both the sample and chamber walls will emit equivalent radiation The capacitance method should be impervious to the high temperatures Also during FY-83 an acoustic-electric field hybrid module will be designed and constructed The final major objective in FY-83 will be to build and initiate tests on an elevated temperature electric field positioning module

W83-70358 **179-20-57**
Jet Propulsion Laboratory, Pasadena, Calif
SPHERICAL SHELL TECHNOLOGY STUDY
T G Wang 213-354-6331
(179-20-55)

The long range objectives of this task are to (1) study the dynamics of liquid bubbles and of the gravitational effects relevant to the production of spherical shells both in the laboratory and in a weightless environment, develop the technology that is pertinent to the production of metallic and metallic glass shells of various dimensions and aspect ratios, (3) develop and construct high temperature and high cooling rate facilities that are needed to produce refractory metallic and metallic glass spheres, and (4) develop technology applicable to the production of a novel high strength low weight material by bonding of the spheres In order to produce the high quality spherical shells that are required, three parameters must be controlled accurately the shell dimensions, shell sphericity, and concentricity, and the surface topology of the shell The present shell fabrication techniques are not set up to study the fundamental physical processes which control those parameters separately Attempts to conduct experiments on the dynamics of liquid bubbles (molten shells) in laboratories are limited by a strong coupling among the three parameters, time, gravity, and temperature The work described here will circumvent these limitations and enable detailed study of each of the important processes through use of low gravity environments collectively available in drop towers, in KC-135 flights, in a neutrally buoyant immiscible system, and in an acoustic levitation system

W83-70359 **179-40-62**
Jet Propulsion Laboratory, Pasadena, Calif
EXTRATERRESTRIAL MATERIALS PROCESSING
Paul G Gordon 213-354-8610
(179-10-62)

The objective of this RTOP is to develop and implement a program plan for the utilization of space resources The plan, which is titled 'Use of Space Resources' will provide the guidance for initiating ground based experiments to develop a data base for future planning of space operations The Jet Propulsion Laboratory has already been working on the first phase of this plan and the effort will be expanded to include university participation Coordination of the effort will be provided by P G Gordon who will be assigned as a detailee to NASA Headquarters, Office of Materials Processing in Space

W83-70360 **179-40-62**
Marshall Space Flight Center, Huntsville, Ala
MPS AR&DA SUPPORT
J R Williams 205-453-5961

The objectives of this RTOP are to provide the necessary management and support manpower to implement the materials processing in space (MPS) research and technology development effort, and to provide the MPS program with an effective means of interacting with the various scientific communities involved for the purpose of (1) making them aware of the research opportunities offered by the MPS program, (2) stimulating their interest and active involvement in the program, (3) gauging their response to the scientific results being obtained by the program, (4) identifying research areas in which the program should concentrate, (5) initiating in-house research activities in selected topics pertinent to the MPS program, and (6) evaluating the ongoing research effort The MSFC will ensure the necessary professional and supporting manpower to implement the MPS research and technology development effort Also, the stated objectives will be met by actively involving the various research communities in the MPS program through working groups, seminars and workshops, science reviews, and a visiting scientist program In addition, scientific goals and accomplishments of the program will be documented and disseminated to the science communities in the form of a published bibliography and catalog of tasks

W83-70361 **179-46-20**
Jet Propulsion Laboratory, Pasadena, Calif
RESEARCH OF THE USE OF SPACE RESOURCES
R A Boundy 213-354-4299
(179-45-20)

The objective of this RTOP is to develop an understanding of the basic physical properties and principles which control the rates and the practicality of candidate extraterrestrial materials processes That understanding will allow objective decisions to be made regarding processing and use of extraterrestrial materials in space It will also provide the technical foundation for a development program when a decision is made to proceed with utlization of space materials The specific objective for FY-83 is to continue and extend the FY-82 effort to evaluate the feasibility of candidate processes with emphasis on understanding the underlying physical principles and rate determining parameters Analytical and experimental investigations will concentrate on silicate processing, magma electrolysis, and vapor phase separation Analysis will continue on alternate (new) processes, as well as supporting technologies (transportation, energy), exploration, and resource identification In vapor phase separation emphasis will be put on the selective ionization processes In magma electrolysis emphasis will be on melt properties and process depleted compositions In silicate processing the emphasis will be on melt studies and compaction-densification of mock silicate materials The strong university involvement initiated in FY-82 will continue and will compliment the in-house effort

W83-70362 **179-60-62**
Marshall Space Flight Center, Huntsville, Ala
COMMERCIAL MATERIALS PROCESSING IN LOW-GRAVITY
R L Brown 205-453-4880

The overall objective of this RTOP is to foster commercial uses of materials processing in low gravity (MPLG) technology in ways which will lead to new or improved processees/products on Earth and in space, and thus to benefits for the general public The overall approach involves working directly with private and select federal organizations to stimulate interest in MPLG and lay the groundwork for use of MPLG in ways which will benefit the public Due to the embryonic nature of MPLG technology at this time, an in-depth working relationship must be established with interested organizations wherein they can develop an understanding of how MPLG technology can meet their specific needs Also, the factors which influence the development of an infrastructure to support an MPS industry or industry segment must be understood This RTOP provides for developing three progressive levels of working relationships on a case-by-case basis, as well as for developing an understanding of the technical and institutional issues which influence technological innovation based on MPLG technology

W83-70363 **179-75-10**
Marshall Space Flight Center, Huntsville, Ala
CLOUD PHYSICS
J R Williams 205-453-5961

The goal of this research is to better understand the microphysical processes in atmospheric clouds responsible for precipitation formation, electrical properties of clouds, and the production/removal of gases and aerosols in the atmosphere The dominant microphysical processes are phase transitions, fluid flow and gas or particulate transport at or near phase transition interfaces, charge transfer and other electrical phenomena, etc The approach is to define and execute experiments and supporting theoretical studies which will improve understanding of the fundamental properties of these microphysical experimental concepts which utilize low gravity environments provided by KC-135 aircraft or Space Shuttle flights

W83-70364 **179-80-30**
Marshall Space Flight Center, Huntsville, Ala
CONTAINERLESS PROCESSING
J R Williams 205-453-5961

The objectives of this activity are to (1) explore novel techniques and applications for containerless processing or glasses and refractory materials, (2) understand the limitations imposed by the gravitational field, and (3) evolve meaningful flight experiments which extend processes

beyond gravity limitations Containerless processing in space requires low level levitation forces to compensate for microgravity acceleration and maintain position of the sample The central reason is the elimination of extraneous effects from contact with solid containment walls The implementation of appropriate experiments will involve the following (1) a 31-meter drop tube at MSFC provides 2 6 seconds of free fall for solidifying molten droplets up to several mm diameter (2) a single axis acoustic levitator has been developed which uses a high-Q driver with a single resonant frequency, (3) a three-axis acoustic levitator has also been under development involving three mutually orthogonal drivers which produce a three-dimensional sound field (spherical energy well) in a tuned cavity, (4) a 10 kW electromagnetic levitator facility, which by careful coil design maximizes Grad B/B, is in use to levitate samples with a mimimum of heating, and (5) aerodynamic levitation using a jet of air from a carefully designed nozzle has been used to suspend highly reactive samples

W83-70365 **179-80-40**
Marshall Space Flight Center, Huntsville Ala
BIOSEPARATION PROCESSES
J R Williams 205-453-5961

The long range objective is to utilize the environment of space to separate and purify biological products The intermediate objectives are to develop the required technology and to expand the base of knowledge involved with processing biologicals in space, to identify, evaluate and select the most promising processes and to explore new areas of separation technology Separation and purification procedures which have been found to produce inadequate results on the ground because of gravity dependent problems will be evaluated and investigated More specifically, this program will (1) determine possible advantages of the low gravity environment for separation and characterization of biomedical materials (2) design and conduct experiments in space, (3) apply ground/flight knowledge to the improvement of bioprocessing procedures on Earth (4) develop broad and strong collaborative interactions with researchers and (5) identify and explore new techniques of separation or bioprocessing that might be enhanced by low gravity

W83-70366 **179-80-51**
Lewis Research Center Cleveland Ohio
REDUCED GRAVITY COMBUSTION SCIENCE
Thomas H Cochran 216-433-6897
(506-56-21, 694-01-01, 694-03-01)

The objective of this effort is to provide the capability to conduct research in space on fundamental combustion phenomena in order to define governing mechanisms, validate theoretical models, and obtain unique data unavailable to date because of the limiting and masking effects of gravity Work in this RTOP will be devoted to (1) an assessment of the program by a group of recognized scientific experts (2) the preliminary design of individual experiments to be flown on the orbiter middeck and (3) the definition of a Spacelab facility The LeRC will provide the technical and management support to direct all contract activities and to provide coordination between government groups contractors, and the scientific community associated with this effort

W83-70367 **179-80-60**
Marshall Space Flight Center, Huntsville, Ala
SOLIDIFICATION PROCESSES
J R Williams 205-453-5961

Control of the solidification of metal and alloys is keyed to gravitational effects such as buoyancy-driven convection Thus the objectives of the study are to (1) identify various aspects of solidification phenomena that may be affected by gravity-driven flows (2) devise and conduct critical experiments in both increased gravity as well as in space, and (3) impact the field of metallurgy by fundamental knowledge through devising better control strategies Multicomponent metallic systems involve a first-to-freeze component which nucleates and begins to grow causing the composition ahead of the solidification front to change dramatically Where it is infeasible or undesirable to provide controlled gradients for a planar solidification front dendritic growth results Thus, concentration is one of the more fundamental problems involved in the formation of dendrites Directional solidification affords a degree of control because of unidirectional thermal gradient can be imposed and growth rate regulated Another important class is the monotectic alloys which have a region of immiscibility Finally nucleation and rapid solidification of deeply undercooled melts will be pursued by containerless melting and solidification

W83-70368 **179-80-70**
Marshall Space Flight Center, Huntsville Ala
CRYSTAL GROWTH PROCESSES
J R Williams 205-453-5961

In any crystal growth system, an important problem is that the compositional and/or thermal fluctuations in the fluid phases cause compositional inhomogeneities and defects in the growing crystal Where these fluctuations are caused by convection and sedimentation, they can be reduced in low gravity Therefore the major objectives of this crystal growth program are to (1) understand the role of gravity and determine limitations in Earth's gravity, (2) determine and demonstrate advantages to be obtained by growing crystals in space and (3) apply the findings to help solve problems in the growth of electronic and detector crystalline materials The types of growth that will be explored in this program include melt, solution, vapor, and float zone growths Crystal growth by solidification from the melt is the most widely used technique for high technology single crystalline materials The success of the technique depends on the control of the composition, temperature, and morphology of the solidification interface Advantages of this technique include the control it provides over the temperature of growth and visocity In the vapor approach, there are two distinct mechanisms for growing a crystal the physical vapor deposition and chemical vapor deposition Finally, floating zone crystal growth is accomplished by supporting a polycrystalline rod at both ends, melting a portion of it with a moving heater and growing a crystal behind this zone

W83-70369 **179-80-70**
Langley Research Center Hampton, Va
CRYSTAL GROWTH RESEARCH
R K Crouch 804-827-3535

The objective is to develop growth techniques and theories leading to improved bulk semiconductor single crystals that are required for future electronic device capabilities Analytical studies and laboratory investigations will be conducted to define better the causes of crystalline defects such as voids, dislocations grain boundaries and inhomogeneities in these materials Special emphasis will be placed on the effects of convection and on crystal growth in space

Solar Terrestrial and Astrophysics SR&T

W83-70370 **188-38-51**
Marshall Space Flight Center, Huntsville, Ala
DEVELOPMENT OF EXPERIMENTS AND HARDWARE FOR SOLAR PHYSICS RESEARCH
M J Hagyard 205-453-0118

The objective of this program is to test a prototype of an instrument for a flight experiment to measure very small variations in total solar flux as a new technique for critical study of the dynamics of convection and magnetic fields in the solar convection zone The approach is through development of an instrument a crystal cavity radiometer, which uses the extreme stability of oscillation of a quartz crystal as a sensitive indicator of changes in solar irradiance

W83-70371 **188-38-51**
Jet Propulsion Laboratory, Pasadena, Calif
DEVELOPMENT OF EXPERIMENT AND HARDWARE
J H Underwood 213-354-7375

The ultimate objective of this program is to advance the physical understanding of the upper atmospheres - chromosphere, transition region and corona - of the Sun and solar-like stars To this end, new instrumentation is being developed to image the Sun with ultrahigh spatial resolution in the soft X-ray and extreme ultraviolet (EUV) spectral regions (lambda $<$ 300 A), and to improve spectroscopic measurements in this region in particular in the relatively unexplored band 25 A $<$ lambda $<$ 170 A This new instrumentation is based on the fabrication of X-ray/EUV reflectors by vacuum deposition These reflectors, which may be viewed either as mirrors reflecting a specific band of wavelengths or as artificial crystals acting as Bragg diffractors, are composed of two materials arranged in ultra-thin alternating layers of uniform thickness The resulting periodic structure is exactly equivalent to a quarter-wave stack in ordinary optics and reflects X-rays according to the Bragg relation With the new instruments it will be possible to make plasma diagnostic measurements with a spatial resolution much smaller than existing instrumentation allows Hence it will be possible to study the size scale over which the dominant energy input and transport mechanisms in the upper solar atmosphere are effective A prototype instrument will be developed for rocket flight under this task It is proposed to collaborate with Dr E C Bruner of Lockheed Palo Alto Research Laboratories to fly a small solar multilayer telescope as a piggy-back instrument on a Lockheed rocket The telescope will obtain photographs in the coronal line of CVI at 33 7 A

W83-70372 **188-38-51**
Goddard Space Flight Center, Greenbelt, Md
DEVELOPMENT OF SOLAR EXPERIMENTS AND HARDWARE
Stuart D Jordan 301-344-6184

The objective of this RTOP is to develop scientific instruments which contribute to the solution of well-defined solar research problems These activities have the ultimate objective of flying payloads on problem-oriented missions These research programs will form the bases for missions using the Shuttle or free fliers One of these will be a study of coronal structures contributing to the solar wind and the interplanetary plasma A second will be a study of the sources of high energy particles of the Sun, emphasizing instrumentation not accommodated by SMM and/or supplementary to the SMM instruments All instruments will operate with the same temporal and spatial resolution to the maximum possible extent The instruments considered for these payloads include the EUV and soft X-ray spectroheliographs and spectrographs for observation of structures in the corona and active regions with 1 arc sec spatial resolution and spectral resolution down to 10 mA and high resolution X-ray and gamma-ray telescopes In general support of the programs for instrument development is the investigation of critical optical components for ultraviolet and soft X-ray wavelength studies This covers the design fabrication and testing of segments of surfaces of resolution and nonsymmetrical, aspheric surfaces for Wolter Type-II grazing incidence telescopes

W83-70373 **188-38-52**
Marshall Space Flight Center, Huntsville, Ala
GROUND-BASED OBSERVATIONS OF THE SUN
M J Hagyard 205-453-0118
(188-38-53)

The objective of this research is a program of ground-based observations for basic research concerning solar vector magnetic fields and for support of NASA solar missions using the facilities of the MSFC Solar Observatory In the program for basic research theoretical and observation programs are undertaken to study vector magnetic field structures which are relevant to current problems in solar physics To support future NASA solar programs, techniques of observation and of data reduction and analysis are developed using the MSFC vector magnetograph such techniques will generate guidelines for operations of planned space-based magnetographs and will provide more focussed direction for the research performed with these instruments Support of ongoing NASA solar missions is provided through daily observations, transmission of magnetograms to P I s and other relevant personnel, and through coordinated observing programs associated with collaborative investigations with mission P I s

W83-70374 **188-38-52**
Goddard Space Flight Center, Greenbelt Md
GROUND-BASED OBSERVATIONS OF THE SUN
J M Hollis 301-344-7591

The major objectives of this program are (1) to obtain and analyze observations of solar photographs (velocity and magnetic fields global oscillations and wave motion, coronal holes, active regions and flares, etc) at wavelengths observable from the ground which complement UV EUV X-ray and gamma-ray experiments on NASA flight missions such as the Solar Maximum Mission (SMM) (2) to support operational planning for spacecraft experiments, (3) to conduct basic research and develop specific instrumentation and observational progress relevant to objectives for future flight missions (4) to analyze comet tail photographs to determine the velocity field of the solar wind, and (5) to analyze comet-tail photographs to determine the three dimensional structure of interplanetary sector boundaries caused by the solar magnetic field The Vacuum Telescope at Kitt Peak National Observatory is supported by the Laboratory through its Southwest Solar Facility High-resolution, full-disk magnetograms and 10830A spectroheliographs are routinely obtained and substantial observing time is dedicated for special-purpose programs of spacecraft support and basic research by Laboratory staff

W83-70375 **188-38-53**
Marshall Space Flight Center, Huntsville Ala
STRUCTURE AND EVOLUTION OF SOLAR MAGNETIC FIELDS (LABORATORY & THEORY FOR SOLAR PHYSICS)
R L Moore 205-453-0118
(188-38-52)

The basic empirical properties of solar magnetic fields and their effects in the solar atmosphere will be determined by analyzing MSFC vector magnetograms along with complementary data from other observatories and from SMM Observed effects will be interpreted with physical models Electric current and magnetic energy in active regions will be studied to obtain the surface distribution of the vertical current, evidence for the distribution of current above the surface and estimates of the total magnetic energy and net Lorentz force Magnetic structure and evolution of active regions will be studied to determine how magnetic flux disappears from the surface of the Sun the field configurations in which flares occur and how these configurations form short-term magnetic evolution triggering flares, and magnetic structure and dynamic phenomena in sunspots Magnetic transients in flares will be investigated to examine synchronism with impulsive energy release and the relation of photospheric magnetic changes to magnetic transient in chromosphere and corona in filament-eruption flares Solar cycle studies will be investigated to examine further analysis of the poleward meridional flow and polar field injections inference of the operation of the solar cycle, and statistical properties of active regions The study of fine-scale magnetic structure and activity in quiet regions will focus on ephemeral active regions and spicules and their relation to coronal heating, as well as the modeling of inhibition of heat conduction into transition region by magnetic construction

W83-70376 **188-38-53**
Goddard Space Flight Center, Greenbelt Md
EXPERIMENT DEVELOPMENT - LABORATORY AND THEORETICAL SOLAR PHYSICS
Stuart D Jordan 301-344-6184

The primary objective is to support the laboratory s on-going programs by developing fundamental techniques for the interpretation of solar data Specific goals include correctly interpreting the nature of observable solar phenomena by understanding fundamental spectroscopic processes, and understanding the flow of mass, energy and momentum from a mechanical energy reservoir such as the convection zone to the chromosphere and corona Focus will be on (1) the conversion of mechanical energy associated with the photospheric velocity fields into a nonthermal energy flux, (2) the propagation of this nonthermal energy from its point of generation within the photosphere to the chromosphere and corona, (3) the irreversible conversion of this energy into thermodynamic end products within the chromosphere and corona (4) the nuclear processes occuring in solar flares, observed in the gamma ray spectrum (5) consolidation of the above processes into models that predict new solar phenomena and explain those already observed and (6) the calculation of atomic transition probabilities and studies of atomic collision processes in solar plasmas

W83-70377 **188-41-21**
Marshall Space Flight Center Huntsville Ala
GROUND-BASED OBSERVATIONS, UV AND OPTICAL ASTRONOMY
G A Gary 205-453-0110

An observational and interpretive program of astronomical spectroscopy will be pursued using the Echelle grating nebular spectrograph This will include a program of observations and data interpretation concerning internal velocities in HII regions

W83-70378 **188-41-22**
Jet Propulsion Laboratory, Pasadena, Calif
GRAVITATIONAL WAVE ASTRONOMY AND COSMOLOGY
F B Estabrook 213-354-3247

Under this RTOP, research will be conducted in three areas of general relativistic physics gravitation wave detection, cosmological background radiations, and theoretical problems in general relativity The first and major effort is the developmemt of spacecraft Doppler detection of gravitational waves In previous work, the primary noise problems for Doppler detection have been studied One result was the identification of the most critical technological advance required a higher frequency (X-band) carrier signal for Doppler tracking Concerted efforts to urge this development have followed, and we are now participating in its implementation at JPL Further investigations will be conducted to determine the best experimental techniques for gravitational wave detection and to quantify those non-plasma-induced noise problems which are likely to dominate when X-band tracking becomes a reality Data reduction techniques and objective filtering algorithms will be devised, based on our derivation of the response of Doppler links to incident gravitational waves Past theoretical cosmology research led to a proposal from JPL for a microwave radiometer experiment which is incorporated in the forthcoming COBE mission Sophisticated models of the evolution of the IGM were developed The amounts of background radiation in a number of spectral regions are determined, and comparison with relevant COBE data will be used to discriminate acceptable evolutionary models Two areas of theoretical research in nonlinear mathematics are proposed, related to understanding the sources and propagation of gravitational radiation New mathematical techniques developed by the group will be applied to help elucidate the physics of rotating sources, and to search for gravitational wave 'solitons' The discovery of such solitons would contribute to the understanding of wave propagation and would identify specific shapes of pulse signals to be detected in gravity wave experiments

W83-70379 **188-41-24**
Goddard Space Flight Center, Greenbelt, Md
ULTRAVIOLET DETECTOR DEVELOPMENT
D Weistrop 301-344-5781
(506-54-56)

The objective is the development of a photon-counting detector suitable for future space astronomy missions The detector will be sensitive to far ultraviolet wavelengths, and have a large format and high resolution The design is exceedingly flexible, so that once the concept has been proved, future detectors can be optimized for particular missions The detector to be built consists of an image converter/intensifier module fiber-optically coupled to a mosaic of charge coupled devices (CCD's) which provide a digital readout The photocathode is deposited on the input side of a large microchannel plate (MCP) intensifier The output from the MCP is proximity focussed onto a phosphor screen which is intagliated into the cores of a fiber-optic coupler The coupler module consists of a 3 by 3 array of fiber-optic tapers, each of which is coupled to a single CCD The CCD's are read out in parallel A prototype consisting of a small MCP coupled with a single fiber-optics taper and CCD will be fabricated and tested The experience gained in the prototype design and fabrication will be fed-back into the development program

W83-70380 **188-41-51**
Goddard Space Flight Center, Greenbelt, Md
UV AND OPTICAL ASTRONOMY
A Boggess 301-344-5103

The objective is to pursue a long range program in astronomical research with emphasis on detector and instrumentation development, theoretical astrophysics relevant to the interpretation of space observations, and other specific topics of special interest to NASA The effort includes operation of ground telescopes, evaluation of new instrumentation for potential space application, and development and evaluation of detector systems that are candidates for space flight In the course of evaluating detectors and instruments, spectroscopic and photometric data are obtained from ground telescopes concerning the properties of stellar atmospheres, nebulae the interstellar medium, and galaxies Nonequilibrium model atmospheres are being investigated to interpret spectral observations from space observatories Theoretical investgations are carried out regarding the formation and evolution of galaxies and on the evolution of stellar interiors, variable stars, novae, and planetary nebulae

W83-70381 **188-41-53**
Ames Research Center, Moffett Field, Calif
THEORETICAL STUDIES OF GALAXIES, ACTIVE GALACTIC NUCLEI, AND QUASI STELLAR OBJECTS
L J Caroff 415-965-5536

The objective of this work is to conduct theoretical studies on important fundamental problems in the development of density inhomogeneities in the post-radiation dominated Universe and the subsequent formation and evolution of galaxies, and in the structure and dynamics of quasi stellar objects and active galactic nuclei Much of the effort falls under the aegis of computational astrophysics, making use of existing numerical codes for hydrodynamics and radiative transfer as well as developing new ones An important aspect of this area of study is the development of a general method for modeling random phenomena, which will have wide application to many areas of astrophysics

W83-70382 **188-41-55**
Goddard Space Flight Center, Greenbelt, Md
INFRARED AND SUB-MILLIMETER ASTRONOMY
M J Mumma 301-344-6994
(196-41-54 398-41-01, 154-50-80, 157-05-50)

The scientific objective of this program is to provide better understanding of the current state and evolution of astronomical objects This is achieved by observations at wavelengths from 1 micron to 1 mm and at spectral resolution (lambda/delta lambda) from 1 to 10 to the 7th power Since atmospheric opacity and emissivity prohibit or severely limit ground based observations at certain wavelengths (e g 4 to 8 and 13 to 700 microns), high altitude observational platforms such as the C-141, balloons, or satellites must be used High sensitivity composite bolometers are being developed in the far infrared to take maximal advantage of low background conditions achievable at these altitudes A balloon-borne 1 2m telescope is used to conduct a photometric survey of galactic sources of submillimeter radiation, and at least a partial survey of extragalactic sources at these wavelengths An infrared sky camera is also used to quickly map various sources Infrared and submillimeter coherent (heterodyne) spectrometers are developed and used to measure completely resolved intensity profiles for neutral and ionized molecular and atomic lines Correlative studies are made when possible to enable maximum insight into the physics of the medium

W83-70383 **188-46-56**
Goddard Space Flight Center, Greenbelt, Md
PARTICLE ASTROPHYSICS AND EXPERIMENT DEFINITION STUDIES
F B McDonald 301-344-8801

The objective is to study the properties of the cosmic radiation in order to understand its origin and propagation, and to study the properties of the sites in which element synthesis and acceleration take place The particles observed are the nuclear and electronic species of the cosmic ray particles their energy spectra, their charge and isotopic composition, and their distribution in space Some of these objectives can be met through the imaginative use of short duration observations on balloons and utilizing week-long observations on Spacelab Many heavier, larger-area payloads will require a space platform Experiments which much be outside the magnetosphere can be done on Explorer class spacecraft Supporting these objectives is both the development of new detector systems for studying the properties of solar and galactic cosmic rays and the associated development of theoretical studies relating to the sites, origin, models for acceleration, mechanisms for particles transport, etc , related to these experiments The emphasis will be on studying the solar charge composition in the iron to uranium region, on precise measurements of isotopic abundances of solar and galactic cosmic rays, and to accurately determine the charge composition of galactic cosmic rays at the highest possible energies

W83-70384 **188-46-57**
Marshall Space Flight Center, Huntsville, Ala
GAMMA RAY ASTRONOMY AND RELATED RESEARCH
Gerald J Fishman 205-453-0117

An observational program in gamma ray astronomy and cosmic ray research is being pursued using balloon-borne experiments Techniques and instrumentation for future spaceflight experiments are developed concurrently

W83-70385 **188-46-57**
Jet Propulsion Laboratory, Pasadena Calif
GAMMA-RAY ASTRONOMY
A S Jacobson 213-354-6263

This RTOP describes the JPL program in X- and gamma-ray astronomy, part of which is carried out in close collaboration with the Space Radiation Laboratory on the CIT campus The primary objective of the program is the development and application of instrumentation to observe gamma-ray line spectra in the energy range from 02 to 10 MeV from extraterrestrial objects The scientific objectives are to obtain information on nucleosynthesis, galactic structure and the physical conditions in cosmic X-ray and gamma-ray sources, both constant and time-varying The major effort under way is the development of a next generation balloon-borne instrument of significantly improved spectral and angular sensitivity The specific objectives for FY-83 are to continue the design and fabrication of this new instrument and the development of improved gamma-ray sensor elements

W83-70386 **188-46-57**
Goddard Space Flight Center, Greenbelt, Md
GAMMA RAY ASTRONOMY
C E Fichtel 301-344-6281

The technical objective is to develop the most appropriate detector system for the observation of the astrophysical sources of very energetic photons The first approach was the development of a large high energy telescope using digitized spark chambers Many major improvements to this basic telescope system are still being pursued and other approaches to detector systems are now being developed for the high energy, intermediate energy and low energy gamma-ray observations In the medium energy interval (8 to 50 MeV), a second generation experiment has now been flown on a balloon In the 1/2 to 40 MeV region different detection processes become dominant and hence, new detector techniques are required A totally new detector is currently being built based on the Compton interaction process In the 0 03 to 10 MeV region, much of the radiation may consist of monoenergetic line components, therefore, high resolution spectrometers also being developed which will be capable of sufficient precision to resolve lines as narrow as may be found in nature In the high energy region improvements in the track imaging chamber systems are continuing, and special attention in the track imaging chamber research is now being directed towards drift chambers and larger spark chambers At the same time, several approaches are being explored to improve angular resolution, including techniques to concentrate on higher energy photons Improved attitude and aspect systems are being built

W83-70387 **188-46-59**
Goddard Space Flight Center, Greenbelt, Md
X-RAY ASTRONOMY
E A Boldt 301-344-5853

Celestial X-ray sources have introduced us to rich new aspects of astronomy ranging from the millisecond bursts of hard X-rays coming from the innermost orbits of matter falling into a black-hole to the diffuse emission from extensive hot plasmas associated with clusters of galaxies The combination of large sensitive area, low detector background, high temporal resolution and nondispersive spectroscopy over a broadband width has been the approach in discovering and exploring these phenomena The power of this approach has been well demonstrated Extending it with improved spectral resolution and broadband imaging is a major area of development now indicated This involves the creation and evaluation of new systems incorporating low noise ionization counters of optimum resolution, large area X-ray concentrators and imaging devices

W83-70388 **188-46-59**
Marshall Space Flight Center, Huntsville, Ala
X-RAY ASTRONOMY
Martin C Weisskopf 205-453-5133

Research will be conducted in the field of X-ray astronomy in areas related to the Astrophysics programs of NASA Existing satellite and ground-based observations of the time variability of the X-ray sources and their optical counterparts will be analyzed and interpreted Where applicable, auto-and cross-correlation techniques, shot model, and pulse-shape-innovation techniques will be utilized to determine the underlying pulse shape and stability as a function of time An advanced X-ray polarimeter will be designed, built, tested, and flown in a sounding rocket The polarimeter will utilize the polarization dependence of the photoelectric effect and, in particular, the angular dependence of certain fluorescence photons on the linear polarization of the incidence X-rays

W83-70389 **188-46-59**
Jet Propulsion Laboratory, Pasadena, Calif
X-RAY ASTRONOMY CCD INSTRUMENTATION DEVELOPMENT
A S Jacobson 213-354-6263

Recent tests have demonstrated that virtual-phase, charge-coupled devices (CCDs) have high spatial resolution, moderate spectral resolution, and high detection efficiency for single X-ray photons The objective of this RTOP is to develop a CCD-based imaging X-ray spectrometer for X-ray astronomy observations, and to use this instrumentation to study *the temperature and abundance distributions as well as the state of* ionization of cosmic X-ray sources Using a CCD detector of the type which is available now, a spectrometer will be developed, tested, calibrated, and used at the focal plane of a rocket-borne, grazing incidence telescope A parallel detector development program will optimize CCD properties which are required for operation at the focus of advanced grazing-incidence X-ray telescopes

W83-70390 **188-78-38**
Jet Propulsion Laboratory, Pasadena, Calif
STARPROBE - ADVANCED TECHNOLOGY MANAGEMENT & PLANNING
J E Randolph 213-354-2732

This RTOP covers funding for the STARPROBE advanced technology management and planning program in FY-83 to maintain cognizance over the advanced technology support provided by NASA-OAST The objectives of the FY-83 STARPROBE program are to (1) maintain the liaison between JPL and NASA-ARC in the development of the thermal shield for the STARPROBE mission, (2) develop a test plan for the shield materials testing in the spring of 1983 at the CNRS solar furnace, (3) work with the ARC contractor in developing the test samples, fixtures, and data analysis plans, and (4) continue the long term STARPROBE planning by completing a new advanced technology plan and a new program plan and schedule A small cadre of part-time personnel will continue the technology liaison with ARC and assist in the preparation of test plans and future program plans

W83-70391 **188-78-38**
Marshall Space Flight Center, Huntsville, Ala
ADVANCED MISSION STUDY - SOLAR X-RAY PINHOLE SATELLITE AND LONG FOCAL LENGTH CORONAGRAPH
J R Dabbs 205-453-3430

Hard X-ray imaging (10 keV to 100 keV) from solar flares will *contribute not only to knowledge of the sources directly associated* with the chromospheric manifestations of flares, but will also help in exploring the corona A solution to the problem of achieving significantly better angular resolution for hard X-rays lies in the 'Pinhole Experiment' concept An equally important use of the Pinhole satellite will be its application as an external occulter for coronagraph observations of the solar corona Previous feasibility studies investigated alternative stabilization techniques and preliminary optical systems design for a long focal length coronagraph which will be flown on a Spacelab mission utilizing a boom deployed occulting and aperture mask Separations on the order of 50 meters could afford subarc-second X-ray imaging of the Sun and also provide highly effective occultation experiments in both visible and UV regions The Spacelab facility is expected to mature into longer focal length facilities either adjunct to the Space Platform or as separate freeflyers

W83-70392 **188-78-41**
Marshall Space Flight Center, Huntsville, Ala
GRAVITY PROBE - B
A K Neighbors 205-453-1232

The scientific goal of Gravity Probe-B is to confirm Einstein's general theory of relativity This is to be accomplished by measuring gyroscopic precession in a free-flying spacecraft in polar orbit about the Earth This project involves complimentary efforts at MSFC, Stanford University, and the University of Alabama in Huntsville The work is a coordinated theoretical, experimental and engineering program with the definition phase (Phase B) begun in FY-81 and development phase (Phase C/D) to start in FY-84 with a launch in FY-93 The GP-B is planned as an In-House MSFC project with the instrument to be developed by a Stanford University-managed contractor

W83-70393 **188-78-51**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED TECHNOLOGICAL DEVELOPMENT, GENERAL. SIGNAL AND DATA PROCESSING ELECTRONICS; SOLID STATE DETECTORS
D E Stilwell 301-344-6454

The objectives of this research project are to develop and test new onboard signal handling, processing, storage, computing and auxiliary circuitry for use in energetic particle and astrophysics experiments on spacecraft, rockets, balloons, etc , as well as special test and analysis equipment applicable for both ground and Shuttle usage The growing complexity of experiments and the corresponding increase in the volume of data obtained have made signal handling, data processing and data transmission capability-limiting factors To reduce the transmission of unnecessary data, it is necessary to increase the experiment's on-board signal handling and data processing capability This program is approached through the investigation and development of new techniques for signal shaping and handling, data processing and auxiliary circuitry, as well as the modification of existing techniques using advanced technology and materials, including MOS/LSI technology, thick film techniques, multiple chip techniques, and microprocessors The technical objective of the research project is to conduct a program of research and development, and device test and evaluation of silicon and germanium nuclear radiation detectors with emphasis on (1) the improvement of detector technology, (2) the understanding of the radiation and chemical damage effects on device operation and lifetime, (3) the establishment of technology for the fabrication of specialized devices not available from industry, and (4) continued pragmatic life testing

Planetary Astronomy

W83-70394 **196-41-50**
Goddard Space Flight Center, Greenbelt, Md
GROUND-BASED INFRARED ASTRONOMY
V G Kunde 301-344-5693
(188-41-55, 154-50-80)

The scientific objective is to determine spectra resolution ground-based measurements in the intermediate infrared, information on astrophysical objects, such as molecular clouds, interstellar lines, molecular and circumstellar components in stellar atmospheres, and planetary atmospheres A spectrometer system employing a cryogenic Michelson interferometer (77K) is being developed to meet the simultaneous requirements of high spectral resolution, a wide free spectral and range and high sensitivity An optical retardation up to 25 cm will provide an unapodized spectral resolution up to 02/cm in the 400 to 2000/cm range A post-dispersed detection system is being developed to reduce background noise from a warm telescope system and the atmosphere at the detector, thus allowing the multiplex advantage of the interferometer to be retained The cooled instrumentation with the post-dispersed detection system, operating at a favorable infrared site, will allow maximum sensitivity to be attained for an interferometer system at a ground-based site The sensitivity level for a measurement in the 1000/cm (10 micrometers) region with a 122 cm diameter telescope, an integration time of 60 minutes and a spectral resolution of 0 2/cm is approximately 5 x 10 to the -26th power watts/sq m/hz The S/N level for Jupiter

in the 1000/cm region with the above system is approximately 7 for one minute integration time and full spectral resolution of 0 02/cm Initial observations will be made during FY-83 with the low spectral resolution post-dispersion system at the KPNO FTS

W83-70395 **196-41-52**
Goddard Space Flight Center, Greenbelt, Md
IMAGING STUDIES OF COMETS
John C Brandt 301-344-8701

This RTOP provides for the operation of a small high altitude observatory, Joint Observatory for Cometary Research (JOCR), for imaging research on comets and their interactions with solar radiation and the solar wind This research is carried out with ground-based images alone or if suitable data from spacecraft such as Solar Polar Mission is available, with an appropriate combination of ground-based and in situ measurements It should be noted that funding under this RTOP provides support for the operation of the observatory only analysis of research results is funded by the interested Program Office In addition, when suitable bright comets appear radio observations will be made at existing national facilities, and other visible wavelength observations will be carried out at other suitable facilities The observatory site in central New Mexico is one of the darkest sites left in the continental U S Extensive photography of comets Kohoutek, Kobayashi-Berger-Milon and West has been carried out These photographs show extensive features in the plasma tail 0 1 a u from the head which have been analyzed for phase speed and estimates of the tail magnetic field We convincingly associated a structure in comet Kohoutek on January 20, 1974, with a specific excursion in the polar solar-wind speed, this is a first In addition, disconnection events (DEs) of the plasma tail have been convincingly shown to result from sector boundary crossings and magnetic reconnection

W83-70396 **196-41-54**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED INFRARED ASTRONOMY AND LABORATORY ASTROPHYSICS
Michael J Mumma 301-344-6994
(188-41-55 154-50-80)

The objective of the advanced infrared astronomy program are to study the molecular constituents of solar system objects (e g , planetary atmospheres and comets) through observations of their IR line spectra, and so to further knowledge about (1) molecular abundances, (2) kinetic, vibrational, and rotational temperature distributions (3) kinetic velocity shifts (winds), (4) vertical and spatial distributions and (5) ambient gas densities, and to carry out comparative studies of these objects The physical information sought is contained in the intensity profiles of isolated spectral lines and can be obtained by inversion of the observed line shapes The measurement of spectral line shapes has recently become a tractable problem at IR wavelengths, and line shapes can now be measured by infrared heterodyne spectroscopy The approach is to develop and employ coherent detection line receivers for use in the infrared wavelength regions The infrared optics incorporate either gas lasers or semiconductor diode lasers as local oscillators and HgCdTe photo-mixers The intermediate frequency signal is fed into a GSFC standard spectral line receiver which analyzes, displays and outputs the spectral lines Initial observations with this system have been from the ground, but it has been developed with an eye toward flights on the NASA C-141 and in space Laboratory work on precise line frequency determinations and on pressure broadening effects is also carried out in support of the field experiment

W83-70397 **196-41-67**
Ames Research Center, Moffett Field Calif
PLANETARY ASTRONOMY AND SUPPORTING LABORATORY RESEARCH
R W Boese 415-965-5510

The composition of planetary atmospheres and surface and the abundance, temperature and pressure of certain atmospheric constituents can be determined by spectroscopic observations from ground-based and from airborne observatories Such data are necessary for the preparation of valid model atmospheres, which are needed to evaluate the possibilities of life on the planets and to design systems for exploratory missions and for the preparation of evolutionary models of planetary interiors The objectives of this work are to obtain, study and analyze spectroscopic observations of the planets and their satellites, to obtain and analyze, in the laboratory, spectra appropriate for valid interpretation of planetary observations, and to develop the analytical and computational techniques necessary to interpret planetary spectra in terms of real planetary atmospheres and surfaces The objectives will be pursued by measuring, in the laboratory, basic molecular parameters such as absorption line and band intensities band modeling parameters, absorption line half-widths, vibration-rotation interaction constants, and line pressure induced shifts and absorption The dependence of these parameters on pressure and temperature will be obtained by using long path gas cells, cooled gas cells and high resolution spectrometers and interferometers operating primarily in the infrared Spectra of the planets and their satellites will be obtained by using airborne and ground-based telescopes and will be analyzed to obtain information about the composition and structure of their atmosphere and the compositon of their surface

W83-70398 **196-41-68**
Ames Research Center, Moffett Field, Calif
DETECTION OF OTHER PLANETARY SYSTEMS
D C Black 415-965-5495

The long range objective of this activity is to develop a comprehensive program to detect other planetary systems The near term objectives include the funding of selected University researchers to pursue modest exploratory developmental and observational programs as well as theoretical studies directed at identifying optimum techniques for ground-based planetary detection systems The choice of University researchers will be based on a peer review of unsolicited proposals, and it will be guided by the basic recommendations set forth in Volume 1 of NASA CP-2124 Funding will also be used to support in-house theoretical research at Ames Research Center related to the detection and study of other planetary systems

W83-70399 **196-41-71**
Jet Propulsion Laboratory, Pasadena, Calif
OPTICAL ASTRONOMY
T V Johnson 213-354-7427

The objective of the ground-based optical astronomy task is to study planets and their satellites, by means of ground-based observations, at visible and near-infrared wavelengths (approximately 0 3 to 2 0 microns) This task consists of (1) investigating the physical and chemical properties of the upper tropospheres of Venus, Jupiter Saturn, Uranus, and Neptune through high resolution astronomical spectroscopy and spectrophotometry, (2) investigating the physical state and bulk motions of the neutral sodium cloud associated with Io, through a variety of advanced high resolution spectroscopic techniques, and investigating the temporal and spatial behavior of the Na D-line emission from the Jovian satellite Io (J-1) through a synoptic program of spectroscopic observations, and (3) making comprehensive observations through Fabry-Perot spectroscopy and CCD images of the visible and near infrared emissions from trapped ions in the Jovian magnetosphere, leading to a detailed description of the evolution and physical characteristics of the Jupiter/Io S2 - S3 nebula The ground-based optical astronomy task also provides limited operational support (equipment maintenance and setup, observing assistance) at Table Mountain Observatory (TMO) to programs supported from other sources The principal program supported in this manner is the asteroid dynamics task under the supervision of A Harris (JPL)

W83-70400 **196-41-73**
Jet Propulsion Laboratory, Pasadena, Calif
RADIO ASTRONOMY
M J Klein 213-354-6160

The long range goals of this task are to develop observation strategies and state-of-the-art receiver systems for the investigation of solar system objects in the submillimeter spectral region The submillimeter spectral region is virtually unexplored, and NASA is currently considering a space telescope (LDR) to close the existing gap between the millimeter and far infrared spectral regions This task supports the long range goals of the LDR Space Telescope Strong rotational transitions of many important atmospheric molecules populate this largely unexplored spectral region and the potential for planetary spectroscopy is very promising Observation strategies and techniques will be developed to explore this potential by designing and carrying out specific experiments in the millimeter and submillimeter spectral range Specific objects to be observed will include comets and planets On the instrumentation side, the specific objectives are to design and construct state-of-the-art receiver systems for millimeter and submillimeter observations made from high altitude sites, aircraft and eventually from space Associated digital systems are also constructed and maintained The specific ongoing work of this task is the development of a 600 GHz heterodyne receiver and a 300 GHz cooled mixer receiver

W83-70401 **196-41-75**
Jet Propulsion Laboratory, Pasadena, Calif
COMETS
R L Newburn Jr 213-354-2319

Once the perihelion of any cometary orbit lies among the planets, brought there perhaps by stellar perturbations, the orbit begins to evolve rapidly compared to the age of the solar system Once the perihelion reaches 3 to 5 AU, the comet begins to change physically with great rapidity, typically becoming an inert, degassed body after 1000 revolutions

Physical activity changes the orbit and orbital changes alter the physical activity The objectives are to investigate the dynamics and orbital evolution of several periodic comets and their end products, their attendant meteor streams, and to maintain a continuing program of ground based physical observations of comets and the interpretation of these observations, giving emphasis to a quantitative understanding of the physical processes which give rise to the phenomena of nucleus, coma and tails The intent is to intercompare many comets in order to enhance the value of data taken on those few that become targets for space missions Ground based observations will be carried out at Mauna Kea Lick and other observatories using the best auxiliary equipment available at each An investigation will be continued of the dynamics and orbital evolution of several periodic comets and their attendant meteor streams The obvious nongravitational forces affecting the motions of comets will be modeled by assuming these forces are due to the rocket effect of outgassing cometary ices Once the astrometric cometary observations for each comet have been used to refine the existing nongravitational force model, the cometary nucleus spin direction, spin axis evolution and nuclear ice volatility can be inferred For those comets with associated meteor showers, the meteor shower data will be used to characterize the dust distribution in the neighborhood of the parent comet

W83-70402 **196-41-76**
Jet Propulsion Laboratory Pasadena, Calif
ASTEROIDS
D L Matson 213-354-2984

The objective is to understand asteroids their origin, compositions, relations to other planets, satellites and comets and to study any hazards they pose to mankind through impacts on the Earth This task supports telescope observations and the determination of orbits and ephemerides for faint asteroids and newly discovered objects The objectives for FY-83 are to continue observations of faint asteroids and comets The spectral reflectances of asteroids are measured This allows the classification of asteroids by parameters which are related to composition and size In the coming year photometry at wavelengths of 0 56, 1 2 1 6 and 2 2 microns will be carried out for selected asteroids Objects of special opportunity or interest will be studied by CVF spectrophotometry and photometry at 3 5 4 8 10 and 21 microns The dynamical evolution of the asteroid belt and rings of the outer planets will be studied The existence of periodic motion of these systems will be examined and long term predictions of future evolution will be provided A search program is designed to discover new members of the Apollo, Amor and Aten asteroid groups All of these objects must be discovered on their close approaches to the Earth They are so small that at other times they are not locatable even with large telescopes

W83-70403 **196-41-77**
Jet Propulsion Laboratory, Pasadena, Calif
PLANETARY INFRARED IMAGING
R J Terrile 213-354-6158

The objective is to provide high spatial resolution, ground-based infrared and visible images and spectra of the Jupiter Saturn, Uranus and Neptune systems These data directly support instrumentation on the Voyager mission to Jupiter, Saturn Uranus and Neptune and the proposed Galileo mission to Jupiter Jupiter will be observed in the 5 micron window into the deep atmosphere as a continuation of a very successful program to monitor Jovian weather patterns throughout the Voyager postencounter period Saturn will be observed at various infrared wavelengths in order to determine if atmospheric features seen from the ground can be correlated with those observed by Voyager instruments Ground-based observations will be combined with Voyager imaging science and infrared interferometer spectrometer (IRIS) data Imaging data collected with a CCD coronagraph at 8900 A and scan data in the infrared at 2 2 microns will allow detailed observations of Saturn's E-ring and provide ground-based information on Jupiter's newly discovered ring and satellite 1979 J1 This same CCD system will be used to observe the newly discovered satellites of Saturn and to conduct satellite searches around Uranus and Neptune Several comets will also be studied in the visible and infrared including a search for comet Halley and observations designed to determine the albedo and size of the nucleus Observations will be made with an existing infrared imaging system at the Hale 5-meter telescope at 1 to 5, 8 to 14 and 20 microns and scans will be acquired at the 3-meter NASA IRTF at Mauna Kea Observatory Also, CCD images will be acquired from the Palomar 5-meter and 1 5-meter telescopes using an existing camera and data analysis facility at Caltech Uranus and Neptune satellite searches will be conducted from the du Pont 2 5 meter telescope at Las Campanas Observatory in Chile

Life Sciences SR&T

W83-70404 **199-10-00**
Lyndon B Johnson Space Center Houston Tex
INFLIGHT MEDICAL SUPPORT
James S Logan 713-483-4021

The objective is to evolve in a progressive manner an in-flight medical support capability for use in the STS and Space Operations Center era which will provide the following medical support functions (1) crew health mantenance (2) laboratory capability (3) therapeutic intervention (4) emergency resuscitation and life support, and (5) data management An in-flight medical support capability will be developed Requirements for in-flight medical support of a long duration manned space station must be identified They will be derived from four major areas (1) previous medical in-flight experience (2) projected medical scenarios having a small but finite probability of occurrence (3) mission related spacecraft and environmental hazards and (4) health maintenance and preventive medicine Medical procedures such as CPR and routine blood and sample handling must be evaluated and modified for a microgravity environment

W83-70405 **199-10-11**
Lyndon B Johnson Space Center Houston Tex
OPERATIONAL LABORATORY SUPPORT
W H Shumate 713-483-4461

The objective is to provide medical operations support by the Johnson Space Center to approved Agency programs The medical operations support includes the conduct of studies to investigate countermeasures to physiological changes which occur when man is exposed to the spaceflight environment clinical laboratory support of astronaut health programs pre-and postflight testing of astronauts and, operational tests and studies of the spacecraft environment, life support equipment, habitability systems, medical procedures, and support equipment Discipline oriented laboratories will be maintained in each of the physiological problem areas

W83-70406 **199-10-12**
Ames Research Center Moffett Field Calif
OPERATIONAL LABORATORY
H Sandler 415-965-5745
(199-10-11)

The objective is to provide support for the operation and maintenance of Ames Research Center facilities utilized in the performance of research within the Operational Medicine Program Funds will be utilized to operate and maintain the Human Research Facility Human Centrifuge, VAX computer Water Immersion Facility, and for the payment of test subjects and support service contractors

W83-70407 **199-10-21**
Lyndon B Johnson Space Center Houston, Tex
MEDICAL OPERATIONS LONGITUDINAL STUDIES
Sam L Pool 713-483-4461

The objective of the research covered by this RTOP is to conduct longitudinal retrospective and prospective studies of the medical data on the U S astronauts some of whom have flown in space, and a control group of JSC civil servants matched 4 1 on the basis of age, sex race, and education The studies covered involve individuals in a closed population in an attempt to relate changes in physiology and/or pathology to specific factors associated with individual traits of the astronauts and occupational exposure Areas of study and of particular interest consist of acute responses and long term adaptative mechanisms to weightlessness variations in demonstrated performance during structured, complex psychomotor tasks and, finally the effects if any of the occupational exposures to health outcome, including physiological alterations, aging, and disease/disorder incidence

W83-70408 **199-10-22**
Ames Research Center, Moffett Field Calif
LONGITUDINAL STUDIES
H Sandler 415-965-5745
(199-10-21)

The objectives are (1) to obtain analyze and evaluate echocardiograms obtained from humans during simulated weightlessness (2) to investigate the effects of age and gender on the ability to withstand simulated Shuttle reentry G levels, and (3) to evaluate anti-G suits as a protective measure during simulated Shuttle reentry stresses Male and female human subjects of different ages will be subjected to bed rest as a means of simulating weightlessness and inducing the physiological deconditioning associated with spaceflight Echocardiograms will be obtained before, during and after bed rest to assess the effects of hypokinesia on the heart

W83-70409 **199-10-31**
Lyndon B Johnson Space Center Houston, Tex
CREW HEALTH MAINTENANCE
James S Logan 713-483-4021

Maintenance of space crew health is a primary objective of the manned spaceflight program This RTOP is designed to provide guidance procedures and equipment to achieve this objective both now and in the distant future Furthermore a strict modular approach will be followed, thereby assuring a timely growth pattern for hardware development and diminishing the tendency toward sudden obsolescence of an entire system because of one subunit s inadequacy The concept of health maintenance can be dissected in the following way disease prevention, disease diagnosis and disease treatment The tasks contained within this RTOP are directed toward one or more of these concepts

W83-70410 **199-10-32**
Ames Research Center, Moffett Field, Calif
CREW HEALTH MAINTENANCE
H Sandler 415-965-4745
(199-10-31)

This RTOP proposes to conduct research directed towards maintaining crew health during spaceflight Specific research objectives are (1) to identify and evaluate pharmacologic countermeasures for cardiovascular deconditioning during spaceflight (2) to evaluate preflight exercise training as a potential countermeasure for physiological deconditioning experienced during spaceflight and (3) to compare weightlessness simulation techniques and actual preflight, inflight and postflight biomedical data Human subjects will be subjected to bedrest and water immersion as a means of simulating the physiological deconditioning which occurs during spaceflight Responses of exercise-trained and sedentary individuals to these simulations will be compared Techniques such as echocardiography, LBNP ergometry, and Doppler blood flow monitoring will all be utilized in support of the research

W83-70411 **199-10-41**
Lyndon B Johnson Space Center, Houston Tex
SYSTEMS HABITABILITY VERIFICATION
James M Waligora 713-483-5457

A large portion of biomedical research conducted as part of the Space Program has to do with the effect of space specific environments on man and other organisms What may be less obvious as a potential problem is that the environment that man is exposed to in space is almost entirely a man made environment Man environmental factors that are relatively constant in the Earth's atmosphere such as O2 and CO2 concentration and pressure must be carefully controlled by environmental control systems in the space vehicle Acceptable control ranges and emergency ranges for environmental factors must be specified and it must be verified that the spacecraft can maintain the environment within these specifications The specifications must provide for the safety and well being of the crew and must also provide an environment stable enough to allow biomedical study of the space-unique environmental factors In arriving at specifications for these environmental factors, considerations must be given to the difficulty involved in controlling a given environmental factor within a given control range and the implications in terms of cost weight, and reliability Defining these limits and verification that the limits are met in the spacecraft will require research in several specific areas

W83-70412 **199-20-11**
Lyndon B Johnson Space Center, Houston, Tex
CARDIOVASCULAR DECONDITIONING (JSC)
M W Bungo 713-483-5457

The overall goal of this program is an understanding of the cardiovascular changes (termed Cardiovascular Deconditioning') which occur with space flight and their impact on crewmembers Specific aims are to (1) define the underlying mechanisms of cardiovascular deconditioning (2) provide appropriate countermeasures for these effects (3) develop systems to aid in the accomplishment of these goals, and (4) apply the results of the preceding in an operational sense for selection, retention, and health maintenance of future space travelers Ground based studies on both human and animal subjects will in part utilize (1) provocative techniques such as exercise testing and lower body negative pressure, (2) bedrest studies as an analogous condition to weightlessness, (3) noninvasive and invasive cardiovascular monitoring, and (4) pharmacologic interventions, all in an effort to accomplish the goals set forth above Direct inflight applications or continued research will be the continuum Impact will be greater access to the space environment for more diverse segments of the population under a greater variety of conditions

W83-70413 **199-20-12**
Ames Research Center, Moffett Field, Calif
CARDIOVASCULAR DECONDITIONING
H Sandler 415-965-5745
(199-20-11 199-20-13, 199-20-14)

The overall goal of this program is an understanding of the cardiovascular changes that regularly occur with space flight Specific aims are to define the underlying mechanisms of cardiovascular deconditioning, to determine whether specific cardiovascular risks occur with short and long term weightlessness exposure, to develop appropriate countermeasures for observed changes and to develop and implement appropriate space flight experiments To accomplish these goals, ground based studies on both human and animal subjects will be carried out Specific activities will include (1) immobilization (body casting) in animal models (2) determination of the effects of exercise training (3) the use of provocative orthostatic stress tests such as centrifugation, change in body position (tilt) and water immersion, and (4) tests of procedures, devices and drugs to prevent and counteract deconditioning Results should lead to (1) a better understanding of the mechanisms of cardiovascular deconditioning (2) better devices and procedures for modifying deconditioning effects, and (3) specific space flight experiments as an understanding of the risks attendant with space flight Impact will be greatly improved flight safety, access of a broader segment of the population to space flight, and use of the weightless environment to expand our understanding of cardiovascular function

W83-70414 **199-20-21**
Lyndon B Johnson Space Center Houston Tex
SPACE MOTION SICKNESS
J L Homick 713-483-5457

This RTOP has three primary objectives (1) to elucidate the etiology of the space motion sickness syndrome, (2) to develop methods for accurately identifying prior to flight, individuals susceptible to space sickness and (3) to develop effective and acceptable methods for the prevention and treatment of this syndrome A broad based program of interrelated studies will be undertaken Emphasis will be placed on human research Etiological research will be directed toward neurophysiological and behavioral investigations of vestibular proprioceptive and visual function and their interactions Investigations of other sensory systems and physiological functions, spatial orientation and postural control mechanisms will be included to the extent that they may yield information critical to explaining the etiology of space sickness The development of predictors will focus on the establishment of correlations between various vestibular function, motion sickness susceptibility, behavioral and biochemical measurements Detailed evaluations of sensory and physiological adaptation processes as well as various pharmacological substances will be key elements in studies designed to develop countermeasures Throughout the course of implementing this program of research a wide variety of unique hardware devices will be employed which provide required controlled angular and linear accelerations as well as visual, proprioceptive and somatosensory stimulation Parabolic flight experiments will be included to the extent possible

W83-70415 **199-20-22**
Ames Research Center, Moffett Field Calif
BASIC MECHANISMS UNDERLYING SPACE MOTION SICKNESS
N G Daunton 415-965-6245
(199-20-21)

Space motion sickness is a serious problem in manned space flight when astronauts are required to move around and perform complex tasks during the first 3 to 5 days in 0-g During the time that symptoms are experienced, astronauts do not operate at optimal efficiency The objectives of this RTOP are to determine the cause(s) and underlying basic mechanisms of space sickness and to develop methods to predict, prevent, and treat it To accomplish these objectives, a broad based program of interrelated psychophysical neurophysiological, biochemical and neuroanatomical studies on human and animal subjects will be undertaken These studies will be directed primarily toward determining the role of vestibular visual, and proprioceptive systems and their interactions and the role of biochemical factors in the development of motion and space sickness and in the maintenance of orientation and postural control in abnormal motion environments The symptomatology of motion and space sickness will be studied and the effects of the adaptation process and of various pharmaceutical agents on this symptomatology will be determined Studies will be undertaken to identify neurotransmitters and other biochemical factors involved in motion and space sickness Hypotheses about the etiology of, and possible countermeasures for, space sickness will be developed from ground based research Flight experiments will be used to test hypotheses and validate suggested countermeasures

W83-70416 **199-20-31**
Lyndon B Johnson Space Center, Houston, Tex
BONE LOSS
S I Altchuler 713-483-4086
(199-20-41)

Changes in calcium metabolism and losses of bone mineral have been observed in crewmen exposed to weightless space flight The basis of these changes and the underlying mechanisms are not known, nor are the consequences of the alterations which may exist in crewmen during long duration missions understood The goals of this RTOP are to provide ground based research into the mechanisms of the alterations, assessment of the changes in ground based model systems, development of the methods to assess the changes more accurately by noninvasive methods, and then to coordinate these results into the development of countermeasures for the deleterious skeletal changes which occur in crewmen The approach used will be to conduct clinical studies and studies in model systems to determine the precise nature of the changes and the underlying alterations producing these changes biochemical endocrinological, and physical alterations will be studied Correlations will be performed between hormonal and nutritional alterations, and the measured changes in skeletal status and in calcium metabolism

W83-70417 **199-20-32**
Ames Research Center, Moffett Field, Calif
BONE ALTERATIONS
D R Young 415-965-5549
(199-20-31 199-20-34)

Losses of bone mineral have been observed in crew members exposed to weightless space flight The basis and the underlying mechanisms of the alteration is not known and the consequences for passengers and crew members in future long duration space flight have not been assessed The goals of this RTOP are to clarify the mechanisms producing skeletal alterations in hypodynamic environments to determine the remedial measures for the prevention of alterations, to develop noninvasive measures of skeletal status and assist in the development of operational guidelines for crew safety Solution of the problem of bone alterations will be based upon identification of the physiologic mechanisms, the severity of the problem and determination of the extent and manner in which those changes are reversible Animal models will be studied for an in-depth analysis of bone mass loss in ground based simulations of hypogravic environments The studies will emphasize investigations of mechanisms of bone formation rate, bone resorption rate, and related metabolic events as influenced by the acceleration environment Noninvasive measures of skeletal status will be developed Preventative countermeasures will be investigated Human studies will be performed to develop a data base for evaluating noninvasive measures of bone stiffness for the assessment of risk factors associated with bone mass loss

W83-70418 **199-20-41**
Lyndon B Johnson Space Center, Houston, Tex
MUSCLE ALTERATIONS
N M Cintron-Trevino 713-483-4086
(199-20-31)

The regulation of muscle integrity and function during space flight and the causes of its apparent atrophy are the central questions addressed by the present research program It intends as its overall research goals to elucidate and define the mechanisms and biochemical factors operative in the processes associated with muscle metabolism and atrophy during weightlessness and to develop effective countermeasures to these muscle alterations in order to optimize man's performance and recovery upon return to a one-g environment Using animal models, studies to define the molecular mechanisms underlying muscle mass regulation and atrophy will focus on the dynamics, enzyme systems, and effectors of protein and carbohydrate metabolism, the chemical bioenergetics, membrane dynamics and mechanics of contractile function, and the role of motor activity and hormonal influence in the maintenance of muscle function Preventive and remedial countermeasures will center primarily around the influence of exercise on muscle integrity corollary studies will determine the type and quantity of exercise required to curtail the progression of the induced atrophy process

W83-70419 **199-20-42**
Ames Research Center, Moffett Field, Calif
MUSCLE ATROPHY
S Ellis 415-965-5757
(199-20-41)

The overall aims of this research program are to determine the underlying causes for the muscle atrophy problem observed in both humans and animals in space and to develop suitable measures to counter these undesirable changes Specific objectives consist of (1) conducting basic studies into the nature of the biochemical and physiological mechanisms which regulate skeletal muscle mass and properties (2) developing and validating methods for monitoring the rate of atrophy of skeletal muscle in human subjects and laboratory animals, and (3) investigating possible countermeasures which may forestall muscle atrophy induced by disuse and weightlessness Muscle atrophy will be achieved in experimental animals principally by immobilization with casts and in some instances, by suspension hypokinesia In special circumstances denervation, tenotomy, and in some instances, castration will be used to produce atrophy in specific muscles or to evaluate the effects of innervation Since the degree of active or passive tension of a muscle has been shown to play an important role in the development of atrophy this factor will also be examined and controlled in the above models In pursuit of an understanding of the mechanism by which muscle atrophy develops the approaches to be used are principally biochemical and physiological

W83-70420 **199-20-51**
Lyndon B Johnson Space Center Houston Tex
BLOOD ALTERATIONS (INFLUENCE OF SPACE FLIGHT ON THE BLOOD AND BLOOD-FORMING TISSUES)
Gerald R Taylor 713-483-4086
(199-20-60)

The most significant effects of the space flight environment on the blood and blood forming tissues in man have been a postflight reduction in the blastogenic transformability of lymphocytes, a marked lymphocytopenia granulocytosis and a consistent reduction in the circulating erythrocyte mass The variations in the magnitude of the loss in individual crewmen and the complicated postflight recovery kinetics suggest a complex relationship between the red cell mass loss and the duration of the exposure to space flight conditions This anemia of space flight' was frequently accompanied by a reduction in plasma volume apparently occurring early in the mission and sustained throughout the flight Other, more subtle effects have been observed with respect to the function and structure of red blood cells and in the concentration of some plasma proteins The alterations observed within the leukocyte population appear to result from at least two distinct phenomena both of which must be thoroughly studied Postflight changes in the coagulation mechanism have not yet been shown This research program seeks to determine the significance of the reported changes and to determine their medical significance, if any

W83-70421 **199-20-52**
Ames Research Center, Moffett Field, Calif
BLOOD ALTERATIONS
H A Leon 415-965-5359
(199-20-51, 199-20-54)

A decrease in the red blood cell (RBC) mass has been a common finding in human space flights Recent U S and U S S R flights show that this loss can occur in the absence of hyperoxia While it is likely that the decrease is due in part to a decreased production evidence suggests that weightlessness can induce hemolysis in rats Also, the RBC membrane changes noted in Skylab suggest that hemolysis may occur in astronauts also since membrane alterations are often a prerequisite for sequestration and hemolysis The significance of these studies is that hemolysis in weightlessness appears to be an early occurrence The major objective of these studies is to elucidate these hemolytic mechanisms These studies will contribute to an understanding of pathological hemolytic disorders Mammals exposed to high altitude develop an increased RBC mass Rats experience a transient but significant hemolysis upon return to sea level air It is felt that this is a convenient and realistic model for at least a portion of the mechanisms which cause hemolysis in weightlessness Also the RBC membrane will be specifically studied in certain well defined experimental systems

W83-70422 **199-20-61**
Lyndon B Johnson Space Center Houston, Tex
FLUID AND ELECTROLYTE CHANGE
Carolyn S Leach 713-483-4086
(199-20-10, 199-20-30 199-20-50)

Body fluid compartment shift occurs in early exposure to weightlessness These changes are complicated by losses in electrolytes (sodium, potassium calcium, phosphorus, magnesium and chloride) occurring at a slower rate over mission duration which further influence fluid distribution Hormonal responses are elicited to counteract these changes The purpose of this program will be to study these changes and their effect on man s (astronaut and nonastronaut) ability to function in space Results of the investigations in this RTOP will provide an understanding of the physiological and biochemical effects of weightlessness and rationale for nutritional and/or other countermeasures for use in future space flight missions The information gained from exposure of man to weightlessness flight for periods approaching three months has shown that fluid and electrolyte metabolism has been altered in all crewmen

studied It is apparent that the changes experienced are multiphasic and are caused not only by the weightless environment but also by conditions related to the preparation for flight, the activity during flight, and the recovery procedures

W83-70423 **199-20-62**
Ames Research Center, Moffett Field Calif
FLUID AND ELECTROLYTE CHANGES
L C Keil 415-965-6378
(199-20-61)

The primary objective of this RTOP is to investigate and characterize the physiological mechanism(s) responsible for in-flight changes in fluid/electrolyte metabolism Once the mechanism is known appropriate administration of dietary or hormonal agents during flight may be used to restore or prevent excessive fluid/electrolyte loss To investigate the fluid/electrolyte mechanism affected by headward fluid shifts, data will be obtained from horizontal and head-down human bed rest studies These data will be analyzed and compared to that generated in animals subjected to similar episodes of blood redistribution in an effort to define the responsible mechanism(s)

W83-70424 **199-20-71**
Lyndon B Johnson Space Center, Houston, Tex
RADIATION EFFECTS AND PROTECTION
D S Nachtwey 713-483-5281

This RTOP describes a long term program of research to determine the nature of the space ionizing radiation environment and its consequences for manned space operations While currently available information is sufficient for early Shuttle missions, research priorities of the attached program are based on the assumption that NASA's long term plans will involve men in geostationary orbit before the year 2000 Based on knowledge obtained from previous research under this RTOP, exposure to ionizing radiation may be the limiting factor in both mission duration and total career for the crew Furthermore, shielding considerations, especially for protection from solar particle events, may influence significantly the detailed design and total mass of a spacecraft To provide timely solutions to these problems in the mission planning stage, the underlying research must be conducted now A plan is presented for research in specific areas of radiobiology and radiation dosimetry Specific attention is given to the effects of high energy particles of space since the problem is unique to NASA A nonfunded coordination effort with other NASA RTOP's and programs of related government agencies will augment the information required by NASA in its long term radiation research effort

W83-70425 **199-20-72**
Ames Research Center, Moffett Field, Calif
BIOLOGICAL EFFECTS OF PARTICLE RADIATION
D E Philpott 415-965-5218
(199-20-71, 199-20-76)

This program is designed to assure human safety in space operations with respect to the radiation risk factor posed by high energy particles (HZE s) The objectives of the research program are to determine (1) short term and long term effects of HZE particles on cells and organs (2) threshold of exposure for long term effects which would be deleterious to normal functions, e g , vision and behavior, (3) cancer risk and effects on the rate of CNS aging following HZE exposure Experimental animals will be exposed to HZE particles at the Lawrence Berkeley Laboratory or other suitable facility Damage in the retina, brain, and other organs at varying intervals after irradiation will be determined by pathological, morphological, biochemical, and physiological methods Data will be acquired on dividing and nondividing cells in response to low dose HZE's Life span studies will be conducted in animals following low dose irradiation and the rate of aging in selected organs and tissues will be determined by light and electron microscopy and cytochemical techniques Animals will received gross and microscopic examination and the results compared to radiation modality and dose The dose required for biological changes will be related to that required by X-rays to produce the same alterations A ratio, or RBE greater than 1 represents the increased human risk factor

W83-70426 **199-20-76**
Langley Research Center, Hampton, Va
RADIATION EFFECTS AND PROTECTION
P F Holloway 804-827-2893

The objectives of this research are to provide basic radiation protection data and analytical methods for use in assessing optimum dosimetry requirements, human performance factors, impact on mission objectives, and anticipated exposures in various body tissues as input to radiobiological studies (especially in connection with high energy heavy ions) Particular attention will be given to calculating buildup factors for protons, developing multilayered electron environmental data for human protection problems, evaluating self shielding factors, and analyzing protection requirements in Earth orbit as input to mission planning exercises The Langley Research Center will maintain a basic research effort in this area Both the needed expertise and computer facilities required are available at LaRC New analytical methods will be developed for radiation transport which are amendable to mission analysis, and for use in shield optimization procedures Theoretical models of the nuclear reaction of heavy ions are being developed, and complementary experiments are being performed in cooperation with the DOE Extensive reviews and evaluations of existing reaction data and calculational techniques The development of the necessary reaction data base and calculational models must precede the application to specific NASA programs

W83-70427 **199-20-82**
Ames Research Center, Moffett Field, Calif
HUMAN BEHAVIOR AND PERFORMANCE
R M Patton 415-965-6602

Manned space missions require high levels of human performance in unfamiliar and stressful environments Future missions will involve crewmembers, scientist passengers (chosen for their scientific and technical expertise, and not trained as career astronauts) and ultimately people from the population at large Because of the high cost of these missions, and the high value of their successful completion, every effort must be made to maximize the probability of successful performance and adjustment to mission conditions by all crewmembers and passengers This research will (1) develop selection, training and performance monitoring procedures that are appropriate to crews involved in manned space missions, (2) study task oriented groups in order to specify the best structure and composition of groups engaged in manned space missions, (3) study human response to the stresses of spaceflight in order to develop procedures to prevent performance decrements and to remedy those that do occur Both laboratory studies and field studies on earth, which simulate conditions of long duration manned spaceflight will be undertaken to identify the personal, group, procedural and situational characteristics predictive of effective or ineffective performance, and to develop preventive and remedial measures that may be employed in order to counter possible performance decrements

W83-70428 **199-20-92**
Ames Research Center, Moffett Field, Calif
GENERAL BIOMEDICAL RESEARCH
A D Mandel 415-965-5061
(199-20-91)

The main objective of this RTOP is to provide a research program to support preliminary studies in areas not specifically covered by any of the major problem oriented RTOP's If the results of preliminary studies prove to be relevant and of interest to the overall goals and objectives of the biomedical research program, the research will be transferred to one of the major RTOP's for a more thorough study Research within this RTOP presently focuses on studies of (1) infectious disease detection, (2) thermoregulation, (3) neurotransmitter control, and (4) carbohydrate metabolism This program will examine the ability of certain blood components to respond to an infectious agent, and to determine whether or not an individual is in the prodromal stage of an infectious disease Studies will be done in order to determine whether the presence of certain serum components can be used to predict the ability of an individual to react normally to an infection and whether weightlessness can affect immune responsiveness Understanding of body temperature regulation by the central nervous system will be extended by studies to determine active central nervous system sites during pyrogen induced fever Studies will continue on the mechanism of regulation and control of neurotransmitters, especially the role of dietary factors Elements which are concerned with the regulation of carbohydrate metabolism, especially high glucose and saturated fat diets will also be investigated

W83-70429 **199-30-07**
Goddard Space Flight Center, Greenbelt Md
MONITORING LARGE SCALE TOTAL PRIMARY PRODUCTION AND DESERTIFICATION PROCESSES WITH AVHRR IMAGERY
C J Tucker 301-344-7122

The objectives of this RTOP are (1) to produce a spectrally-derived from advanced very high resolution radiometer (AVHRR) data total dry matter accumulation map of African Sahel and Sudan vegetation zones between approximately 10 N to 20 N across entire width of Africa for the 1982 rainy season, and (2) study selected areas in semiarid environments where concern over desertification is focused (i e , Mauritania, Mali, Lake Chad area, Sudan, Saudi Arabia, Pakistan, and India) and determine the utility of AVHRR imagery for monitoring these processes The AVHRR GAC (4km) data will be used for the Sahel-Sudan total dry matter study while AVHRR LAC (1km) data will be used for the desertification studies Research conducted at NASA/GSFC in FY-82

has demonstrated the practicality of both of these undertakings Close cooperation will be maintained with UN/FAO and UN/UNEP groups working in the respective study areas

W83-70430 **199-30-31**
Lyndon B Johnson Space Center, Houston, Tex
GLOBAL ECOLOGY
D Stuart Nachtwey 713-483-5281

The ultimate goal of a global ecology program is to quantitatively understand (i e mathematically model) the interrelationships of the Earth's entire biota and the entire lithosphere-hydrosphere-atmosphere system Some of the elements required for this understanding have been outlined in some detail in reports from two workshops, 'Interaction of the Biota with the Atmosphere and Sediments' (Oct 1979, Washington, DC) and 'Life from a Planetary Perspective Fundamental Issues in Global Ecology' (Summer, 1980, Santa Barbara, CA) At the simplest level, the elements of global ecology consist of the biogeochemical reservoirs of the atmosphere, hydrosphere, lithosphere, and the biota, the fluxes of biogeochemicals between the reservoirs (sources and sinks), and the feedback interactions of the flow of biogeochemicals with each other and with solar radiation It has become clear that purturbations of the balance of flows of specific chemical compounds between reservoirs can lead to significant alterations of the entire interrelated earth system (e g anthropogenic CO2 increase can yield climate change, increases in methane, chlorofluorocarbons, and nitrogen oxides can yield ozone layer change accompanied by solar ultraviolet change)

W83-70431 **199-30-36**
Langley Research Center, Hampton, Va
BIOSPHERE-ATMOSPHERE INTERACTIONS IN WETLAND ECOSYSTEMS
R C Harriss 804-827-3645

The research plan consists of two elements the first of which concerns the biogenic modulation of methane in global troposphere, the role of wetlands Wetlands are hypothesized to be the major natural source of methane to the troposphere Primary objectives in this research include (1) a detailed investigation of microbiological, ecological, geochemical, and physical factors controlling methane emissions from soil and water interfaces to the atmosphere in the great Dismal Swamp, Virginia, will be conducted, (2) methane emissions will be quantified at a wide variety, of swamp, salt-marsh, and peat bog sites in eastern North America, (3) these studies of methane flux in specific habitats will be coupled to remote sensing measurements of ecosystem properties to develop capabilities for extrapolation of in situ measurements to regional and global biogeochemical fluxes The second element concerns remote sensing or ecological assessment of tidal wetlands The proposed research effort will explore the application of multispectral radiance measurements to assessment of biogenic mediation of the global carbon cycle by tidal wetlands

W83-70432 **199-40-22**
Ames Research Center, Moffett Field, Calif
DEVELOPMENTAL BIOLOGY
J Miquel 415-965-5952

The objective of the research described in this RTOP is to identify the effects of gravity and space radiation on plant, insect, and animal development, maturation and senescence, and to examine the evolutionary importance of gravity as a determinant of the function and form of terrestrial life The approach is to evaluate through ground based and spaceflight experiments, the dependence of plant, insect, and animal growth and development on gravity, to assess and understand the mechanisms involved in the effects of gravity and ionizing radiation on the growth, reproduction, development and aging of living forms, and, to evolve concepts, design experiments and establish baseline data for future inflight fundamental research

W83-70433 **199-40-32**
Ames Research Center, Moffett Field, Calif
BIOLOGICAL ADAPTATION
E M Holton 415-965-5471
(199-40-10, 199-40-20)

The overall aims of this research program are to increase our understanding of biological processes as they are affected by the unique environment of space, to identify and assess the biological mechanisms by which living systems respond and adapt to space flight environmental parameters (particularly altered gravity) as well as the interactive affects of gravity and other stimuli and stresses on the physiology and metabolism of organisms, and to determine functional variations and regulating mechanisms at all levels of biologic organization (plants, invertebrates, and vertebrates) using gravity as a tool to yield new understanding about living systems on Earth Biochemical, physiological, and anatomical changes in organisms exposed to altered gravity will be delineated and quantified Altered gravity states will be introduced by means of simulated weightlessness (Holton model and modifications), acceleration (centrifuge) or clinostats Morphologic changes, modified biochemical pathways, and changes in specific physiological functions will be assessed in terms of exposure intensity and duration a significant part of this effort will elaborate on the regulatory factors in homeostatic adaptation to and deconditioning from the metabolic stress associated with a change in the gravity field

W83-70434 **199-50-12**
Ames Research Center, Moffett Field, Calif
CHEMICAL EVOLUTION
H P Klein 415-965-5094
(199-50-32, 199-50-42)

The aim of this research is to understand the origins and chemical evolutionary pathways of organic matter in the cosmos which led, in the case of the Earth, to the emergence of life but which, in extraterrestrial environments, may have taken divergent paths Chemical evolution research encompasses the study of the evolutionary path of carbon and its compounds from the primal fireball, through interstellar clouds, to formation of solar systems, to the beginnings of life on Earth In experiments conducted under conditions designed to simulate the putative environments of cooling solar nebulae, cometary heads and tails, and primitive and contemporary planetary atmospheres and surfaces, the extent and nature of abiotic synthesis of organic matter are determined Natural evidence bearing on the validity and generality of the chemical evolution hypothesis is sought through organic and inorganic analyses of materials having extraterrestrial (e g , meteorites, lunar samples, interstellar dust grains, Martian soil) and ancient and recent terrestrial origin The intimate association of minerals with organic matter everywhere in the cosmos and their necessary cogenesis and coevolution make it essential to understand the influences of one on the other From comparative planetological studies and the study of the organic geochemistry, mineralogy, and petrology of natural samples will come an understanding of the factors that have influenced the course of chemical evolution on planetary bodies and the origin and early evolution of life on Earth

W83-70435 **199-50-22**
Ames Research Center, Moffett Field, Calif
ORGANIC GEOCHEMISTRY
H P Klein 415-965-5094
(199-50-12, 199-50-32 199-50-52)

The objective of this RTOP is to understand the origin and early evolution of life on Earth through studies of organic matter in ancient rocks, contemporary environments, and microorganisms The approach will be to (1) examine stable carbon and nitrogen isotopic fractionation in microbial metabolism, (2) using this knowledge, investigate isotopic fractionation in biogeochemically significant microorganisms in order to learn how they impose their chemical and isotopic signatures upon the organic constituents of rocks, and (3) through field studies, relate these signatures in contemporary environments to their analogs in ancient fossils and sediments

W83-70436 **199-50-32**
Ames Research Center, Moffett Field, Calif
ORIGIN AND EVOLUTION OF LIFE
H P Klein 415-965-5094
(199-50-12, 199-50-42)

The objectives of this research are (1) to explore the mechanisms, processes, and environments associated with the origin(s) and evolution of life on Earth and to ascertain to what extent they represent constraints within which life can develop elsewhere in the Universe, (2) to utilize such information to design models lending themselves to experimental verification The origin of life represents a point on a conceptual continuum that characterizes the physical, chemical, and biological evolution of matter While experimental verification of hypotheses concerned with cosmological and chemical evolution can be carried out on the extraterrestrial stage, studies on the origin and evolution of life are limited to the only experimental material available, terrestrial life Several crucial areas of study have been identified for extensive investigation from which first principles can be discerned and applied to the formulation of a theory for the origin and early evolution of life Two approaches are adopted for studying biogenesis and bioevolution one is to posit plausible models for relevant processes and environments, and test them either experimentally or by the use of computer simulations, the other is to identify early events and their evolutionary context in comtemporary organisms since they are, in fact, repositories of information concerning what took place during the evolution of life

W83-70437 **199-50-42**
Ames Research Center, Moffett Field, Calif
SOLAR SYSTEM ENVIRONMENTS
H P Klein 415-965-5094
(199-50-12, 199-50-22)

The aim of this RTOP is to provide specific information on the chemical composition of the atmospheres and the volatiles in surface and particulate matter of solar system bodies including planets, their satellites, comets, asteroids, meteorites and particulate matter in space This information is essential for selecting or devising the most appropriate model for the evolution of the solar system and for each of the investigated bodies, and will further provide a basis for understanding the conditions necessary for the origin of life by comparisons of the evolutions and the chemistries of these bodies Improved methods and instrumentation will be developed for in situ chemical analyses of the volatile species contained in atmospheres, surfaces and particulates Special emphasis is directed to the development of the gas chromatographic approach since it is now proven to be among the most effective means for measuring complex gaseous chemical mixtures Improvements in the gas chromatography, such as column technology, detector design, and total system design (including work on other subsystems), will be rigorously explored

W83-70438 **199-50-52**
Ames Research Center, Moffett Field, Calif
LIFE IN THE UNIVERSE
H P Klein 415-965-5094
(199-50-12, 199-50-22, 199-50-32)

The objectives are to understand the history of the biogenic elements in the galaxy, in the solar system, and during the early evolution of the Earth to study possible evolutionary pathways for complex life in the Universe and particularly, to examine the influence of astrophysical, stellar and solar system events on the evolution of complex life on Earth This RTOP has two distinct parts the history of the biogenic elements, and the evolution of complex life In each part a series of science workshops is being convened to explore the major scientific questions, to determine which are amenable to theoretical, experimental or observational approaches and to recommend the major elements of a technical plan to pursue those objectives The recommendations of the workshops will then be incorporated into proposals for Agency program plans for the History of the Biogenic Elements and for the Evolution of Complex Life, each to be an element of the Life in the Universe program Each area will include some preliminary tasks which will assist in the crystallization of program plans or which are cogent examples of the type of research appropriate for the two areas As detailed program plans are defined in each area over the next two fiscal years, FY-83 and FY-84, it may be appropriate to split this RTOP into its two major components

W83-70439 **199-50-62**
Ames Research Center, Moffett Field, Calif
THE SEARCH FOR EXTRATERRESTRIAL INTELLIGENCE
H P Klein 415-965-5094

This RTOP supports the development and implementation of the SETI element of the NASA OSSA Life Sciences Division program entitled 'Life in the Universe' The SETI program is a research and development effort which has the following five objectives (1) to conduct an extensive 5-year research and development effort to determine the most cost effective way to do SETI and to carry out limited but significant SETI observations, (2) to design build and test a SETI breadboard system (3) to use the breadboard at Goldstone and Arecibo for initial SETI observations (4) to evaluate the SETI system for its value for radio astronomy, and (5) to explore new technologies for SETI In accomplishing these objectives, telescope SETI hardware interfaces will be determined, alternative observational techniques investigated, and various signal processing and identification methods examined in software and optimized for implementation in hardware Signals of natural and artificial origin will be sought over portions of the sky between 1 and 10 GHz up to a maximum sensitivity of 10 to the -23rd power/sq Wm, and selected solar-type stars will be searched in portions of the 1 to 3 GHz range up to a maximum sensitivity of 10 to the 27th power/sq Wm These initial observations are expected to continue through 1987 The plan is divided into four breadboard phases, each of which improves the breadboard capability

W83-70440 **199-60-11**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED LIFE SUPPORT SYSTEMS
Richard L Sauer 713-483-2759

The objective of this program is to identify the requirements and to develop the technology that will be required to provide the metabolic support systems for the next generation, long duration, manned space missions These metabolic support systems include atmosphere revitalization and control, water reclamation and supply, hygiene and waste management, and food service and supply This RTOP covers the research, development and testing needed to support the eventual design and fabrication of the flight metabolic support systems This RTOP will include the effort required to support the development of the metabolic support systems for a long term orbital space vehicle, and in many instances, will culminate with the fabrication and testing of flight prototype hardware Following system concept identification, technology gaps and needs will be identified to permit timely investigation and solution It is to this and the accompanying development of subsystem concepts, procedures, and developmental hardware that the initial effort will be directed This early effort will provide for alternate and potentially more efficient but less developed concepts where technical trade offs indicate a potential overall benefit to the program through decreased expendable, weight or volume requirements, increased reliability and maintainability, and increased crew acceptability and performance

W83-70441 **199-60-12**
Ames Research Center, Moffett Field, Calif
ADVANCED LIFE SUPPORT SYSTEMS
H P Klein 415-965-5094
(199-60-22)

The objective of this program is to advance the technology base for regenerative life support systems required to support long term manned space missions The regenerative life support processes must provide a more complete system closure (reduction of expendables) The subsystem functions to be investigated and developed include the following air revitalization, atmospheric supply and composition control, water reclamation, and waste management systems Specific life support subsystem technology areas will be investigated (feasibility and/or development) and subsystem concept designs will be generated This RTOP will be directed toward advancing the technology and/or hardware development status for advanced life support subsystems, and will result in achieving a technology base (research and hardware development) for subsystems that have the characteristics of low maintenance, high reliability and long life

W83-70442 **199-60-21**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED EXTRAVEHICULAR SYSTEMS (SPACE SUIT)
Richard E Mayo 713-483-4933

The objective of this RTOP is to develop the technology necessary to provide a high mobility, nonventing extravehicular system (space suit and life support) that will maximize the utility for EVA for servicing Shuttle scientific payloads and for support of EVA for servicing Shuttle scientific payloads and for support of advanced activities such as space station construction There will be active coordination with the OSTS RTOP effort for prebreathe elimination to insure maximum transfer of technology between the two efforts To this end, maximum use will be made of existing hardware interfaces to facilitate near-term use of a higher operating pressure EVA system Competitive solutions for high mobility space suit elements/assemblies will be pursued

W83-70443 **199-60-22**
Ames Research Center, Moffett Field, Calif
ADVANCED EXTRAVEHICULAR SYSTEMS
H P Klein 415-965-5094
(199-60-12)

The objective of this RTOP is to advance the technology base for advanced extravehicular systems required to support manned space missions The advanced extravehicular systems must provide for extended EVA capability This RTOP program will emphasize improved hardware performance, increased hardware and system life, and reduced EVA equipment and payload design, manufacturing, maintenance, and operations costs The technology areas associated with protection of an EVA astronaut will be pursued under this RTOP This includes development of efficient high pressure (approximately > 8 psig) suit components that provide for greater mobility and the development of concepts for passive thermal control

W83-70444 **199-60-42**
Ames Research Center, Moffett Field, Calif
FOOD REQUIREMENTS, PRODUCTION AND PROCESSING FOR CELSS
H P Klein 415-965-5094
(199-60-52)

The objective of this program is to investigate various methods of utilizing processed waste materials to regenerate food in a controlled environment life support system (CELSS) Methods of food production that could be employed in controlled environments will be investigated These include photosynthesis by organisms ranging from algae to higher

plants, and physicochemical methods, such as photoreduction of CO2 In the latter case, reduced organics could be fed to non-photosynthetic organisms, such as yeast and bacteria, which could be used as human food materials after appropriate processing During the early phases of the program, investigation of higher plants will be emphasized Research will be concentrated on plant nutrient requirements, stability and reliability of production, including toxin production and characterization, controllability of growth, and variation in food nutrient value Plants will be selected and evaluated through growth and product analyses in a simulated CELSS environment Plant production techniques will be identified, evaluated and developed Candidate plants and methods will be tested in a simulated CELSS environment in conjunction with waste management and systems management developments

W83-70445 **199-60-52**
Ames Research Center, Moffett Field, Calif
WASTE MANAGEMENT FOR CELSS
H P Klein 415-965-5094

The objective is to plan and conduct the research and develop the technology required to process wastes so as to produce the nutrients necessary for regenerating food in a controlled ecological life support system (CELSS) for space applications Models of the waste materials to be processed by the waste management system in a CELSS for use in space will be developed Exploratory studies will be undertaken of each of the major waste management technologies that have been identified to date as candidates for CELSS The candidate methods are wet oxidation, incineration, aerobic and anaerobic biological oxidation Emphasis in the exploratory studies will be placed on determining the adaptability of a given waste management method to producing a product that can be used subsequently to regenerate food Inherent in this approach is investigation of methods to remove and separate organic and mineral components of the effluent

W83-70446 **199-60-62**
Ames Research Center, Moffett Field, Calif
SYSTEMS MANAGEMENT, CONTROL, AND ECOLOGICAL CONSIDERATIONS FOR CELSS
H P Klein 415-965-5094
(199-60-42, 199-60-52)

The objectives are (1) to identify and investigate biological functions in isolated autonomous systems (CELSS) that must be controlled to achieve stable system operation, (2) to identify and investigate control parameters in biological, chemical and mechanical systems, as well as identify parameter coupling and develop control strategies, and (3) to establish and maintain communication and cooperation among investigators in the CELSS Program The approach used in this RTOP is to develop theoretical and/or experimental investigations of significant problems affecting CELSS system operation, control and stability In addition, because this work intersects other CELSS investigations in the areas of food production (199-60-42) and waste management (199-60-52), certain tasks address problems of promoting an integrated CELSS Research Program, and supporting continuous communication between program investigators and program managers

W83-70447 **199-60-71**
Lyndon B Johnson Space Center, Houston, Tex
MAN-MACHINE ENGINEERING REQUIREMENTS FOR DATA AND FUNCTIONAL INTERFACES
J L Lewis 713-483-4966

To move toward quantification of man-machine engineering data, both on the ground and in flight To continue to pursue state-of-the-art technology and to advance that technology for the purpose of creating more effective and efficient man-machine interfaces for manned spacecraft To improve techniques of man-machine engineering design so that innovative steps may be taken toward creating better crew interfaces in future vehicles To implement a series of continuing tasks to identify and implement workable instrumentation packages for acquiring quantitative man-machine engineering data in one-g, simulated, zero-g, and actual zero-g To continue those efforts currently defined that lead toward definitive design requirements for use as inputs to the Design Performance Lab To pursue feasibility studies of promising new crew interface items

W83-70448 **199-70-12**
Ames Research Center, Moffett Field, Calif
COSMOS FLIGHT EXPERIMENTS PROJECT
E W Gomersall 415-965-5730

The objectives of this RTOP are (1) to determine the effects of spaceflight on a wide range of biological specimens, (2) to use hypogravity as a tool to study fundamental problems in biology which cannot be solved on the ground, (3) to study biomedical problems encountered during manned spaceflight using animal surrogates, (4) to evaluate countermeasures to the deleterious effects of spaceflight, (5) to develop and test life sciences equipment and experimental procedures which could be used to support the flight of similar equipment and experiments aboard the US Space Shuttle, and (6) to stimulate an exchange between US and USSR scientists of information related to spaceflight Following a Soviet invitation to participate in a spaceflight mission, a dear colleague letter is prepared and released Experiment proposals are reviewed and a tentative US payload submitted to the Soviets for approval Experiments selected for flight are funded for a definition phase preflight and a postflight data analysis phase Flight and ground support hardware are developed and tested Final reports are prepared and published

W83-70449 **199-70-32**
Ames Research Center, Moffett Field, Calif
SAMPLE BANK
W E Berry 415-965-5736

The overall objective of this program is to provide a means of increasing the scientific yield from the Spacelab 4 flight by allowing more investigators access to the unclaimed tissue of flight animals and to proceed with simple investigations which will not impact the primary selected studies already approved for the flight Use of this tissue is intended to also complement on-going SR and T programs The specific objective is to request additional tests from the investigator community, including those investigators whose experiments are already selected for this flight The program will be initiated by utilizing input from the investigators selected for Spacelab 4 in a colloquium or as a splinter session of one of the investigator working group meetings Additional suggestions will be requested from all of the investigations currently affiliated with the NASA Life Sciences Program (SR&T) and other University researchers After this contingent has had an opportunity to suggest additional measurements and investigations, it may be possible to open the sample bank program to other reseachers via a simple announcement or 'Dear Colleaque' letter A NASA group will review and select the appropriate new studies from the suggestions and will allow as many additional measurements on the flight animals as is deemed reasonable and prudent This concept is dependent, of course, on the total funding available

W83-70450 **199-80-31**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED EQUIPMENT DEVELOPMENT
R L Frost 713-483-5991

The development of prototype hardware in support of both operational medical investigations during Shuttle flights and possible life sciences experiments during Spacelab flights will be accomplished by this RTOP The hardware will be designed with flexibility in mind to allow the conduct of several similar investigations This RTOP will provide for design studies, development of prototype hardware for testing and detailed design specifications or flight hardware Contracts will be let to consolidate requirements and develop design requirements for hardware optimized to support several investigations Prototype hardware will be procured and evaluations conducted to optimize the design Detailed design specifications will be prepared to support procurement of flight hardware

W83-70451 **199-80-32**
Ames Research Center, Moffett Field, Calif
VESTIBULAR RESEARCH FACILITY (VRF)/VARIABLE GRAVITY RESEARCH FACILITY (VGRF)
R W Mah 415-965-6538

Current theories are that the vestibular system is intimately involved with space motion sickness, as it is with motion sickness A fundamental understanding of the vestibular system is necessary before a satisfactory prevention or cure can be derived Emphasis is placed on fundamental research using animal test subjects, which will enable scientists to conduct investigations not feasible for human subjects The need for a variable gravity research centrifuge in space is well documented Emphasis is placed on studies to define the requirements for providing 1-g control capability in space and for conducting gravitational research in space Based on scientific conclusions reached by the 1979 International Vestibular Meeting and the 1980 Vestibular Meeting (both chaired by Dr M Ross), a ground version of the vestibular research facility (VRF) will be developed for conducting vestibular research Construction of ground science hardware will be completed and will be housed in a functional VRF science facility This ground equipment includes many, but not all, of the stimulus and recording modes of the flight version The Science Advisory Committee for VRF feels that this ground equipment presents a unique opportunity for animal and potentially human research concerning vestibular function This facility will be available for the scientific community to use as described in the VRF scientific research program plan The variable gravity research facility design parameters will be developed through ground tests and the hardware

capability will be developed as an add-on module to the VRF core modules

W83-70452 **199-80-42**
Ames Research Center, Moffett Field, Calif
LONG DURATION LIFE SCIENCES SATELLITE PROGRAM DEFINITION
E W Gomersall 415-965-5730

The objective of this work is to identify science issues, experiment requirements and the technology, subsystem, system, and operational requirements involved in the conduct of non-human, biological research on spaceflights of long duration The current limitation of the time-in-orbit of the Space Transportation System and the Spacelab may not permit a careful and unequivocal resolution of the various biological problems which confront man and other living organisms on spaceflights of long duration Those questions need to be addressed to provide safe and reliable manned flights for extended periods of time In-house studies to identify life science questions and experiment scenarios will be used as a working basis for review by the science community and as inputs to in-house and contracted assessments of future spaceborne research equipment A science advisory team will be appointed In-house and contracted studies will be conducted to develop conceptual experiment equipment, assess critical technology requirements, development of spacecraft system descriptions and tradeoffs

W83-70453 **199-80-48**
Marshall Space Flight Center, Huntsville, Ala
LIFE SCIENCES PAYLOAD ACCOMMODATIONS
J D Hilchey 205-453-3430
(199-80-42)

The objective of this research is to conduct conceptual design studies of accommodating and integrating life sciences facilities for long duration research on non-human test subjects aboard space platforms in order to (1) determine the feasibility of accommodating and integrating such facilities aboard platforms, (2) provide the engineering data, cost estimates and schedules necessary to plan the development of such accommodations and integration capabilities, and (3) synthesize results from a number of parallel studies into a data base to support decisions whether to proceed with a Phase B effort A group of interrelated in-house and contracted study activities includes (1) two parallel, competitively procured, contracted system conceptual design and feasibility studies to provide accommodations and integration conceptual designs, interface *engineering data, and programmatics for life sciences research facilities* aboard platforms, (2) similar in-house activities extending the pre-phase A work accomplished in FY-81, and (3) in-house synthesis of the accommodation and integration system study results to provide the basis for deciding the Phase B course of action

W83-70454 **199-80-52**
Ames Research Center, Moffett Field, Calif
LARGE PRIMATE FACILITY
W E Berry 415-965-5736

The objectives of this RTOP are (1) to obtain scientific guidance for the conceptual design and development of a large primate facility which can be used in the Spacelab and long duration missions, (2) to develop a set of design requirements for a large primate facility, (3) to evolve and evaluate flight hardware systems concepts A science advisory group will be convened to identify science requirements for a large primate facility The set of requirements agreed upon by the advisory group will be used to shape design concepts Conceptual system designs will be evaluated by the advisory group Prototypes of the selected system concepts will be fabricated and tested using procedures suggested by the advisory group

W83-70455 **199-80-62**
Ames Research Center, Moffett Field, Calif
MAMMALIAN DEVELOPMENT FACILITY
W E Berry 415-965-5736

The aims of this research are (1) to provide scientific guidance for the conceptual design and development of a mammalian development facility (MDF) to study early mammalian development (i e , from fertilization to litter development in micro-gravity environments), (2) to identify design requirements for an MDF and (3) to evolve and evaluate flight hardware concepts A science advisory group will be convened to identify science requirements for an MDF to support mammalian development experiments in space The set of requirements agreed upon by the advisory group will be used to establish design concepts for an MDF Conceptual designs will be evaluated by the advisory group Prototypes will be fabricated and tested using procedures suggested by the advisory group

W83-70456 **199-90-71**
Lyndon B Johnson Space Center, Houston, Tex
INTERDISCIPLINARY RESEARCH
Lawrence F Dietlein 713-483-6291

The life sciences directorate at Johnson Space Center is responsible for the development of a comprehensive biomedical research program in support of manned space flight This broad, multidiscipline mandate to acquire new knowledge is directed toward the acquisition of definitive data regarding the effects of the space environment on life systems in order to define the critical physiological and psychological variables which must be integrated into the overall considerations of spacecraft designers and mission planners The objective of the interdisciplinary research RTOP is to provide flexibility in the accomplishment of this goal The responsibility for planning, implementing, and continually evaluating the life sciences programs at Johnson includes the need to provide support for preliminary investigation of various alternative advanced research and technology efforts which might ultimately become part of an approved programmed RTOP assigned to the center An aggressive and responsive attention to alternative advanced programs requires that the center director for life sciences have some autonomous discretion in the pursuit of tentative investigations

W83-70457 **199-90-72**
Ames Research Center, Moffett Field, Calif
AMES RESEARCH CENTER INITIATIVES
H P Klein 415-965-5094

The mission of the life sciences directorate at Ames Research Center (ARC) is to understand the origin of life on Earth and to search for life elsewhere in the universe, to understand the effects of space flight upon humans and other forms, and to provide environments and equipment in spacecraft that will permit crews and passengers to exist safely and perform effectively The goal is to provide flexibility in the accomplishment of the mission by providing support for preliminary investigation of various alternative life sciences research and technology efforts which may result in formal research proposals ultimately becoming part of an approved RTOP The director of life sciences, ARC, will review the proposed efforts and select the tasks which will become part of this RTOP Those tasks which show potential for further research pursuit will subsequently be submitted for future review and approval in the appropriate problem oriented RTOPs

Data Analysis

W83-70458 **385-36-01**
Marshall Space Flight Center, Huntsville, Ala
SPACE PLASMA DATA ANALYSIS
Charles R Chappell 205-453-3036
(188-36-55)

The objective is an adequate understanding of the dynamics of low energy plasma in the Earth's magnetosphere This will be accomplished by (1) analysis of the light ion mass spectrometer data from the SCATHA satellite, (2) laboratory simulation of plasma flow around different objects, (3) modeling of thermal plasma procedures, (4) analysis of data and development of models relating to the effects of spacecraft plasma sheaths upon low energy charged particle data, and (5) development of multispacecraft merged data sets and advanced display techniques

W83-70459 **385-38-01**
Marshall Space Flight Center, Huntsville, Ala
DATA ANALYSIS
E Hildner 205-453-0123

The objective is to understand coronal mass ejections, both in solar corona and in interplanetary space The SMM Coronagraph/Polarimeter data, correlative data, and numerical modeling are used The SMM and correlative data for individual mass ejection events are used to understand thoroughly the events creation and evolution and their relationship to other forms of solar activity A list of coronal transients' occurrence and properties was prepared to facilitate comparisons between and among transient events The behavior of idealized transients near the Sun was calculated through numerical modeling, and the coronal mass ejections in interplanetary space were examined both observationally (if data exist) and by numerical modeling

W83-70460 **385-38-01**
Goddard Space Flight Center, Greenbelt, Md
SOLAR PHYSICS DATA ANALYSIS AND OPERATIONS
Stuart D Jordan 301-344-6184

The objectives are to (1) process, analyze and interpret solar data from flight projects and to continue this work after the initial funding from project offices has been terminated (2) to publish in the scientific

literature detailed studies of phenomena gathered over protracted periods of time which reveal long term features and correlation effects not evident during the prime data analysis, (3) to engage in multidisciplinary studies comparing experimental data from other satellites and/or ground based laboratories in order to investigate in fine detail, fine structure, long term and secular efforts and (4) to provide additional reduced, analyzed data for archive in the National Space Science Data Center During the prime analysis period many theoretical ideas about the observed phenomena are developed and correlations of the data with other ground based or satellite data are suggested In addition, to study a given phenomena over an adequate range of the important indepedent variables such as solar region, wavelength, solar cycle, etc , it is necessary to process large quantities of data covering extended periods of time Thus, additional data will be processed and analyzed, multiexperiment studies will be made and various proposed models or theories will be critically tested by use of these data Ground based spectroheliograph measurements will be correlated with satellite observations

W83-70461 **385-38-01**
Jet Propulsion Laboratory, Pasadena, Calif
SOLAR AND HELIOSPHERIC PHYSICS DATA ANALYSES
M Neugebauer 213-354-2005

Plasma and magnetic field data from ISEE 3 are used to study tangential discontinuities (TD's) in the solar wind The TD's are selected for study because they do not propagate through the wind and thus retain some information about conditions at the solar source Emphasis is given to (1) understanding the frequency of occurrence and the nature of TD's from different sources of the solar wind (2) examining TD's which mark changes of solar wind composition in an attempt to understand the origin of helium abundance variations, and (3) using plasma variations across large, isolated TD's to estimate effective transport coefficients Magnetohydrodynamic (MHD) discontinuities are identified during routine processing of the ISEE-3 magnetometer data (E J Smith, Principal Investigator) Additional MHD discontinuities with smaller magnetic signatures can be found by visual inspection of plots of high time resolution plasma data processed at Los Alamos National Laboratory by the principal investigator for the solar wind experiment (S J Bame) In this work, high time resolution magnetic field data are used to perform a minimum variance analysis to determine the principal axes of the discontinuity Field and plasma data are then combined to determine whether or not a discontinuity is tangential Statistical analyses will be performed on the resulting set of TD's to search for and understand systematic associations with solar wind streams of different origins Multivariable correlation analyses will be performed for the subset of TD's which exhibit changes of helium abundance, and time profiles before and after suitable TD's will be examined in detail to model the rates at which different diffusion processes tend to destroy the discontinuities

W83-70462 **385-41-01**
Jet Propulsion Laboratory, Pasadena, Calif
APPLICATION OF DIGITAL IMAGE PROCESSING TECHNIQUES TO ASTRONOMICAL IMAGERY
Jean J Lorre 213-354-2995

The objective of this task is to provide digital image processing support to astronomers who do not have such a capability and/or who are interested in finding out how image processing can help them in their analyses The intent is to investigate and demonstrate how digital image processing techniques can be utilized in the analysis and display of information from astronomical imagery, to acquaint more members of the astronomical community with the basis for assessing the processing support requirements for Space Telescope imagery It is proposed that the approach which has been successfully utilized for the past four years to accomplish this objective be continued This approach consists of providing a base of funding from which small amounts of money are allocated to specific tasks This is implemented as follows as ideas are conceived, or requests for support are received, they are formulated in terms of a specific task statement and cost Permission to perform each task is then requested from the technical monitor The effort proposed herein provides support for six specific requests for IPL collaboration which have been received during the past year

W83-70463 **385-41-01**
Goddard Space Flight Center, Greenbelt, Md
DATA ANALYSIS ASTRONOMY
J M Mead 301-344-8543
(188-41-51, 188-41-55)

The objectives are to develop tools and techniques which will facilitate and improve the reduction, analysis and understanding of astronomical data primarily through the application of computers for managing large blocks of bibliographical and observational information, including digitized images and spectra, obtained at all wavelengths for stars, galaxies and other extended objects, and to produce a series of monographs on the subject, Nonthermal Phenomena in Stellar Atmospheres This will be accomplished by the (1) expansion of the current machine-readable data base by searching the journal literature, particlularly in the IR and UV, to obtain more complete data and bibliographical coverage combining catalogs of variable stars, cool stars and extended objects, observing with IUE to contribute to our knowledge of astrophysical plasmas A computerized astronomical data retrieval system, with associated software, to produce data searches, digital plots, and bibliographical information for specified catalog ID numbers, positions and other parameters at all wavelengths is proposed Also, operation of an interactive astronomical data analysis facility, which is designed and operated to provide astronomers with the display, enhancement and analysis tools that they need to interpret their digitized images and spectra, and preparation of a series of astrophysics research volumes by laying out the best space data and discussing critically the current theories for interpreting these data are planned

W83-70464 **385-46-01**
Goddard Space Flight Center, Greenbelt, Md
HIGH ENERGY ASTROPHYSICS DATA ANALYSIS
F B McDonald 301-344-8801

The objectives are (1) to process, analyze and interpret galactic, interplanetary, Jovian and solar cosmic ray data from space flight experiments after the immediate funding project offices have ceased and for detailed studies of these phenomena involving multisatellite data sets (2) to engage in multidisciplinary studies comparing experiment data from other satellites, deep space missions and manned missions such as Skylab, as well as using ground-based observations to study in detail a wide range of high energy astrophysics phenomena, (3) to publish these results in the scientific literature and (4) to make the data available to the National Space Science Data Center

Astrophysics Institutional Support

W83-70465 **405-02-02**
Goddard Inst for Space Studies, New York
RESEARCH IN ASTROPHYSICS AT THE GODDARD INSTITUTE FOR SPACE STUDIES AND COLUMBIA UNIVERSITY
Patrick Thaddeus 212-678-5621
(506-54-56)

This RTOP supports all GISS research in observational and laboratory astrophysics and theoretical quantum chemistry, and nearly all research and development in far IR detector development Objectives are (1) to discover new interstellar molecules, (2) to observe known molecules such as CO to study star formation and galactic structure, (3) to analyze COS-B gamma ray and forthcoming IRAS IR observations of molecular clouds, in comparison with CO GISS molecular cloud surveys, (4) to develop new coherent detectors and receivers for the far IR, (5) to undertake far IR spectroscopy in the laboratory to support GISS astrophysical research, (6) to conduct theoretical investigations of molecular collisions and molecular structure to support NASA programs

Technical Consultation and Support Studies

W83-70466 **643-10-01**
Lewis Research Center, Cleveland, Ohio
TECHNICAL CONSULTATION SERVICES
E F Miller 216-433-4000

The objectives are to (1) provide technical consultation services support in the area of space services with particular emphasis on preparing for international meetings relating to the fixed-satellite service (FSS), the broadcast-satellite service (BSS), and the mobile-satellite service (MSS), (2) provide the technical basis and regulatory support needed to obtain sufficient orbit/spectrum to meet current and projected requirements of NASA and the United States, and (3) perform studies, develop analytical methods for planning, conduct evaluations, identify technology status and needs, perform critical technology developments, perform measurements (where necessary) to determine sharing criteria, and evaluate alternatives that result in efficient and cost-effective use of the geostationary orbit/ spectrum resource Specifically, these activities will support domestic and international preparations for the 1983 RARC (Regional Administrative Radio Conference) on broadcasting satellites at 12 GHz, support domestic and international preparations for the 1985/1987 Space Services WARC with emphasis on the FSS and the BSS, and support domestic and international MSS planning in the 806-890 MHz band The described activities will be conducted within

the framework and schedules of the applicable CCIR Study Groups, the special preparatory committees established in the U S , and the national and international meetings called to support preparations for the conferences Efforts planned are a combination of in-house and contract activities

W83-70467 **643-10-01**
Jet Propulsion Laboratory, Pasadena, Calif
SPECTRUM AND ORBIT UTILIZATION STUDIES
Y H Park 213-354-3909
(643-10-02, 643-10-03)

The objective of this RTOP is to ensure the growth of space applications by providing the technical basis and regulatory framework needed to obtain sufficient spectrum/orbit to meet current and projected requirements The results of this work will be used by NASA to help *determine its frequency and orbit requirements and to ensure compatibility* between NASA flight programs and other space and terrestrial services The results will also be used by NASA and other government agencies for the purpose of supporting CCIR and World and Regional Administrative Radio Conferences, in making decisions on frequency/ orbit utilization and assignments, ground-station and satellite approvals, and in providing for the growth of existing and new satellite services The specific objective for FY-83 is to support NASA Headquarters with the analysis of orbit/spectrum issues to develop the domestic and international regulatroy framework for the MSAT-X program and the communications satellite services The approaches are to participate in studies on planning frequency allocation and regulatory framework for the Mobile Satellite Experiment (MSAT-X) program and studies for NASA, CCIR, and Administrative Radio Conferences The studies for the MSAT-X program includes RFI Analysis, Transborder Frequency Sharing, Feeder Link Frequency Assessment, and MSAT-X Regulatory Support The economic/ institutional study on the future mobile satellite will be continued Studies on the fixed, mobile and broadcasting satellite service will be maintained as required

W83-70468 **643-10-02**
Lewis Research Center, Cleveland, Ohio
NEW APPLICATION STUDIES
J R Ramler 216-433-4000
(643-10-01, 643-10-03)

The objectives of this RTOP are to (1) identify and define applications for communication satellites, (2) define preliminary concepts, configurations, requirements, and costs of alternative operational systems for new applications, (3) identify the technologies required to enable the implementation of advanced operational communication satellites, and (4) formulate preliminary plans for developing the required technologies The approach is to formulate and carry out in-house and contracted studies to meet the objectives These studies will be of a scoping nature and will address the technical, economic and institutional/ regulatory feasibility of operational systems

W83-70469 **643-10-02**
Jet Propulsion Laboratory, Pasadena, Calif
COMMUNICATIONS SATELLITE NEW APPLICATION NOTIFICATION STUDIES
F Naderi 213-354-6288
(643-10-01, 643-10-03, 506-61-45)

The general technical objectives of this RTOP include aid in providing for the growth of existing satellite services and new communications satellite applications, and ensuring compatibility of NASA's communications flight programs with other space and terrestrial services This aid is particularly related to NTIA's charter to facilitate the transfer of space technology for public service applications Government procedures require all agencies to submit proposed new space systems concepts to IRAC and OMB for review four to six years prior to their planned date of initial operation This is to ensure spectrum availability for telecommunications systems prior to commitment of public funds In order to fulfill this requirement, this RTOP will include studies of systems concepts with potential applications within the NASA Communications Program These studies will include conceptual designs, user functional requirements, technical requirements, system descriptions, frequency and bandwidth requirements, cost effectiveness, system tradeoffs, and sharing studies required to demonstrate compatibility with existing or planned services In FY-83 this RTOP will concentrate entirely on system studies associated with the planned U S/Canada MSAT Project The system studies to be performed generally fall into two categories the NASA Mobile Satellite Experiment (MSAT-X) definition, and Canadian MSAT/Phase B participation The studies under the first category deal primarily with those areas of particular interest to the U S which have no direct relationship to the spacecraft the studies under the second category include those which jointly affect the experiment definitions of both countries and those which affect the spacecraft design

W83-70470 **643-10-03**
Jet Propulsion Laboratory, Pasadena, Calif
PROPAGATION STUDIES AND MEASUREMENTS
E K Smith 213-354-8040
(643-10-01, 643-10-02)

Radiowave propagation constraints in the earth space environment must be understood and accounted for in the design and specification of space communications systems The Propagation Studies and *Measurements program provides the focal point for national activities* which support NASA's applications programs, development of prediction models, frequency allocation recomendations, orbit and spectrum use decisions, system specification and performance criteria related to space communications The objectives of the NASA Propagation Studies and Measurements Program are to provide an understanding and analysis of the basic propagation mechanisms which hinder reliable earth space communications, and to develop predictive models for the quantitative evaluation of propagation effects in the bands allocated for space applications The objectives of the program are accomplished under three major task activities (1) propagation measurements and experiments, (2) propagation effects modeling and prediction and (3) propagation assessment and evaluation studies The first area is structured to provide the data base, from satellite based experiments (e g , ATS, CTS, COMSTAR and SIRIO) and ground based techniques, for the development and validation of prediction models and system performance The second area supports the development of rain attenuation, depolarization, site diversity, etc , models used for system design applications The third area involves NASA participation in the CCIR (International Radio Consultative Committee), including WARC (World Administrative Radio Conference) preparatory studies and document preparation The publication and updating of the NASA Propagation Effects Handbook for Satellite Systems Design for frequencies below 10 GHz is a major element of this area (companion to NASA Reference Publication 1082, December 1981)

Experiment Coordination and Operations Support

W83-70471 **646-41-01**
Lewis Research Center, Cleveland, Ohio
EXPERIMENT COORDINATION AND MISSION SUPPORT
J R Ramler 216-433-4000

The objective of this effort is to provide continuity of service and orderly transition of user community operations on NASA experimental satellites to commercial satellite systems The approach is to contract with the Public Service Satellite Consortium to assist and coordinate public sector user activities in satellite communications, and to continue development of in-house telecommunications capabilities and facilities to support applications experiments coordination and new satellite communication missions

W83-70472 **646-41-02**
Ames Research Center, Moffett Field, Calif
APPLICATIONS EXPERIMENTS PROGRAM SUPPORT
B P Gibbs 415-965-5001
(643-10-01, 643-10-02, 643-10-03)

The objectives of this RTOP are to (1) coordinate with other Federal agencies and public sector organizations in the development of experimental satellite communications activities for emergency/disaster communication and public service applications, (2) assist users in the transition from the NASA experimental satellite to commercial satellites where continuity of service can be assured, (3) demonstrate Application Technology Satellite (ATS) technology and its applications for other governmental agencies and the public service sector and (4) develop new techniques and applicable hardware for use with ATS To meet these objectives in the development and transfer of satellite communication technologies, the approach will be to conduct satellite demonstrations and experiments using the ATS satellite and engage in direct interaction with potential and ongoing users of the spacecraft This interaction will identify users' needs requiring the development of new technologies

Advanced Communications Research

W83-70473 **650-60-00**
Jet Propulsion Laboratory, Pasadena, Calif
MOBILE SATELLITE EXPERIMENT
Y H Park 213-354-3909
(643-10-01, 643-10-02, 643-10-03)

The overall objective of this RTOP is to develop cost and performance effective technology for the mobile equipment and the base station for first generation mobile communications satellites and the NASA mobile satellite experiment (MSAT-X) program The specific objectives in FY-83 and FY-84 are to develop working breadboards of the mobile equipment with various advanced system design requirements, to develop breadboard base stations including network control systems, and to establish the system design specification for the engineering model of the mobile equipment and the base station to be implemented for the MSAT-X The approach is to perform technology assessment and develop necessary technology under three broad tasks transceiver development, mobile antenna development, and base station development The transceiver development task includes subtasks such as (1) modem development and simulation, (2) coding and compression, (3) control unit, and (4) integrated transceiver breadboard Three breadboards of transceivers will be developed one for the baseline narrowband FM modulation and two for the advanced analog and digital modulation schemes The mobile antenna development task includes development, analyses and evaluation of a high gain electronically tracking antenna and low or medium gain nontracking antennas for the MSAT-X and future mobile satellites The base station development task includes the preliminary system design, assessment of existing hardware, development of breadboards, and prototype design specifications

W83-70474 **650-60-20**
Lewis Research Center, Cleveland, Ohio
SPACE COMMUNICATIONS SYSTEMS ANTENNA TECHNOLOGY
J W Bagwell 216-433-6196
(650-60-21, 650-60-22, 650-60-23)

The objectives of this research are to conduct SR and T development on multibeam antenna system for advanced geostationary communication satellites and supporting Earth terminals Efforts will be directed at applications of such antennas for multiple spot beams and scanning beams Current efforts under this RTOP will (1) develop proof-of-concept hardware of flight systems directed at the experimental verification of multibeam technology in 1988, and (2) develop and evaluate designs for advanced communications equipment for multiple channel Earth stations Dual technology contracts are being pursued during the FY-80/83 time frame to accomplish the near term flight objective A single technology contract is being pursued during the FY-82/83 time frame to accomplish the Earth station near term objective

W83-70475 **650-60-21**
Lewis Research Center, Cleveland, Ohio
SATELLITE SWITCHING AND PROCESSING SYSTEMS
J W Bagwell 216-433-6196
(650-60-20, 650-60-22, 650-60-23, 650-60-26)

The aims of this RTOP are to develop the switching technology for the routing of signals (message traffic) aboard multibeam, multichannel communications satellites, and to develop spectrally efficient, high data rate digital modulation technology Currently work is proceeding under this RTOP via contract for the design and development of a baseband processing (i e digital routing) proof-of-concept system for communications satellite applications, included in which is the development of the enabling LSI technology for system implementation

W83-70476 **650-60-22**
Lewis Research Center, Cleveland, Ohio
RF COMPONENTS FOR SATELLITE COMMUNICATIONS SYSTEMS
J W Bagwell 216-433-6196
(650-60-23, 506-54-04)

The task of this research is to perform supporting research and technology development in the area of space related RF components including power amplifers (tube and solid state), low noise receivers, and other components Initial efforts center on those components identified as needed in the 30/20 GHz band for advanced communications technology satellites (ACTS) systems studies Studies will also determine the ranges of applicability of various component design configurations as functions of performance requirements and physical characteristics, e g volume, weight, power By means of principally a contractual program, the research will develop analysis and synthesis techniques for the above space program components, apply the developed techniques to determine the basic characteristics of components meeting specified requirements, fabricate experimental components, and test and evaluate fabricated components

W83-70477 **650-60-23**
Lewis Research Center, Cleveland, Ohio
COMMUNICATIONS LABORATORY FOR TRANSPONDER DEVELOPMENT AND SATELLITE NETWORK EVALUATION
J W Bagwell 216-433-6196
(650-60-20, 650-60-21, 650-60-22)

The objective of this RTOP is to design and develop a laboratory test facility to be used to test communication system components and subsystems, and to provide laboratory simulations of satellite communications systems The approach will be to design, develop, and test 30 GHz uplink, frequency translator and 20 GHz downlink systems Continous bit stream rates of nominally 50 MBPS and 500 MBPS will be used to modulate the links End-to-end calculations will be made Software simulation results will be compared with the hardware simulation results Upon completion, network control methods will be added and bursty data transmissions will be tested and evaluated in both hardware and software Finally, the baseband processor and several simulated stations will be integrated Software simulations and hardware tests will be correlated to produce a thorough understanding of the multiple facets involved

W83-70478 **650-60-26**
Lewis Research Center, Cleveland, Ohio
ADVANCED COMMUNICATIONS TECHNOLOGY SATELLITE (ACTS) SYSTEM STUDIES
W H Hawersaat 216-433-6685
(650-60-20, 650-60-21 650-60-22, 650-60-23)

The objective is to define Advanced Communications Technology Satellite systems and services that emphasize the high risk technology required to ensure continued U S preeminence in satellite communications The approach is to conduct in-house and contracted studies to assess market needs, determine system requirements and define the satellite systems and services requiring future space-ground advanced communications technology The output from these market operational, and experimental system requirement studies will be used to provide guidelines in the development of requirements for future space-ground advanced communications technology research and development All preproject activities for the first flight experimentation, which focuses on the technology associated with high gain multibeam antenna systems which require flight experimentation as an essential part of their technology development process, are to be identified and carried out Additional efforts necessary to prepare for the first flight including experiment planning activities and in-depth analysis in areas where further definition will assist overall program and project planning, will also be conducted

Data Systems

W83-70479 **656-13-40**
Jet Propulsion Laboratory, Pasadena, Calif
OCEANIC PILOT SYSTEM
C Klose 213-354-6957

The objectives of this activity are to develop, through user interaction, an in-depth understanding of the user requirements for archiving, processing, display, and distribution of remotely sensed and conventional oceanic data sets, evaluate, design, and implement the appropriate computer technologies, standards, and applicable products for an oceanic information pilot system and provide a dedicated computer system on which to develop and demonstrate new capabilities which support the information processing needs of NASA's oceanic research community These objectives will be pursued through the design, development, and operation of an Oceanic Pilot Information System (OPS) This system, implemented on a dedicated VAX computer system provides researchers in the oceanographic community with interactive access to selected satellite and conventional data sets It will be developed in multiple steps The principal reason for a multistep implementation is to make maximum use of feedback from the science community The user group participating in this project will have an integral role in the system development and evaluation The initial uses are being drawn primarily from several institutions having a particular interest in satellite oceanography Scripps Institution of Oceanography (SIO), Woods Hole Oceanographic Institution, (WHOI) Massachusetts Institute of Technology (MIT), Florida State University (FSU), Oregon State University (OSU), Naval Post Graduate School (NPS), and JPL

W83-70480 **656-26-02**
Goddard Space Flight Center, Greenbelt, Md
ATMOSPHERES AND CLIMATE DATA MANAGEMENT
Paul H Smith 301-344-5876
(656-13-30, 656-30-30, 656-44-10)

A pilot climate data base management system (PCDBMS) demonstration system was implemented in FY-82 During FY-83, the objectives of the PCDBMS are to provide data management support to climate researchers, expand the central directory and catalog of OSSA data sets, support atmospheric and meteorological researchers through the data catalog and inventory data bases, evaluate the demonstration system, and develop requirements for a pilot operational system The evaluation and requirements development will be done with the assistance of a scientific advisory group, and will include investigating the use of PCDBMS facility and techniques to provide management of data sets residing on the Goddard applications computing facility The development of the demonstration system will continue in order to support a growing number of users The continuing development will include adding new data sets as well as providing new capabilities to the users of the system In order to achieve the above objectives, the PCDBMS will continue to operate and maintain its computer facility, and provide support for data operations and software maintenance

W83-70481 **656-30-01**
Goddard Space Flight Center, Greenbelt, Md
INFORMATION SCIENCES RESEARCH AND DEVELOPMENT
John C Lyon 301-344-8744

Numerous unsolved problems exist and continue to be discovered in the organization and development of data systems and software for preparation and analysis of data derived from space platforms Such problems are accentuated when these data must be integrated with source information from other measurement and records systems The proposal herein constitutes an integrated and focused approach to the solution of a number of such diverse, but related problems, representing generally recognized critical elements of various applications disciplines support requirements either not or only partially satisfied by existing data systems The problems have been selected under considerations of practicality of solution breadth of potential application, and general significance Topical areas under the initial year of this study program include ten elements in (1) data compression, (2) application of advanced high speed processing technology (3) reduction of labor intensity in analysis systems, (4) improved treatment of and preparation of integrated source data sets, and (5) advanced machine based data handling and information extraction procedures Substantial interplay exists between many of these elements, and practical demonstration of results is proposed to be conducted within existing facilities at the Goddard Space Flight Center via software developed under this proposal Subsequent activities are to be defined as likely extensions of promising results of FY-83 studies, as well as additional problems in system organization and development suggested by perceived need

W83-70482 **656-31-02**
Jet Propulsion Laboratory, Pasadena, Calif
DIGITAL IMAGE RECOVERY AND DATA MANAGEMENT
Michael D Martin 213-354-6065
(656-80-01, 656-13-40)

The primary objective of this effort is to convert the existing set of planetary image data on digital magnetic tape into a data base of well documented and commonly formatted image data sets accessible to users via modern data base management and data communications techniques In addition the effort will identify image data files which have been lost or degraded and allow them to be regenerated before backup data sources (master data records) are also lost or recycled Execution of this effort will allow a minimum of 24,000 magnetic tapes to be released from Federal storage areas The host computer system and data base management system (DBMS) will be selected based on computer availability, cost and compatibility with related projects at JPL (ocean pilot, planetary data systems, multimission image processing laboratory, etc) A common data format for output image files will be designed and reviewed by potential users including the regional planetary image facilities planetary science users, as well as JPL and NASA's end-to-end data system engineers After the selection of the host computer and the DBMS, existing catalog data bases will be loaded into the new DBMS and the production of software to convert existing image data sets to a common output format will begin These programs will interact with the DBMS to extract information necessary for output image labels and to update the data base with processing summary information, location and identification of output image files and engineering parameters extracted from the input data sets Image data set processing will be prioritized by frequency of utilization by the science community and to provide immediate support to research programs in progress

W83-70483 **656-42-01**
Marshall Space Flight Center, Huntsville Ala
MASS STORAGE NETWORK R&D
James L Green 205-453-0028
(385-36-01)

The objective of this research is to support NASA scientific researchers in their satellite and ground based instrument data analysis efforts by developing and demonstrating improved computer-to-computer networking techniques for sharing data among distributed science data bases

W83-70484 **656-44-03**
Jet Propulsion Laboratory, Pasadena, Calif
SAR DATA SYSTEM RESEARCH AND DEVELOPMENT
Chialin Wu 213-354-2061
(506-61-35)

The overall objective of this RTOP is to develop, evaluate and demonstrate data processing techniques and end-to-end data system concepts to facilitate and automate transmission, processing, analysis, and archiving of data gathered by future NASA Shuttleborne and airborne radar sensors The activity is particularly focused on the data handling system for the SIR-B mission, which is the first of a series of synthetic aperture radar (SAR) Shuttle flights to acquire data in digital format A three year plan is proposed here The major thrust of this work is to develop a more flexible SAR data processing system using state-of-the-art programmable array processors which will be able to handle both the SAR correlation and the more general purpose post correlation processing functions A goal is to upgrade the existing interim digital processor (IDP) and demonstrate at least four times increased throughput, which corresponds to 30 minutes per SEASAT SAR frame The benefit is two fold (1) the improved system would provide increased quantity and quality of science data products for SIR-B without increased costs, and (2) the development provides a system technology applicable to future SAMEX data handling needs as well as a number of other NASA remote sensing data processing tasks The plan also addresses SAR data system concepts such as multimission (SIR-B and beyond) data system standards, large volume, high speed data storage devices, and schemes for improving SAR image quality The RTOP includes a plan to upgrade the IDP for SAR correlation and image processing needs in mid 1980's, and a continuing development for the multimission end-to-end data system The RTOP has its short term objectives focused on benefits to the SIR-B project Technology advancement made by this task would, provide long term benefit for all future OSSA sponsored SAR missions including SAMEX, Venus Mapper, etc

W83-70485 **656-44-06**
National Space Technology Labs , Bay Saint Louis, Miss
ADVANCED TECHNOLOGY GLOBAL RESOURCES NETWORK
Sidney L Whitley 601-688-3586

The objective of this effort is to define and implement a global resource information system consisting of an interactive computer network, selected resource related data bases, smart terminal processing systems, software processing and analysis tools, and utilization procedures for use by the global scientific and management community to monitor and/or help solve such problems and areas of concern as the ozone layer, the carbon dioxide problem and to assist in the exploration of energy sources During the first year, a study will be conducted which results in a system design and a preliminary program plan After program plan approval, a prototype system will be implemented and tested in phases within the NASA/University environment, and ultimately in the international community Foreign country participants will be required to share in the implementation costs for the system Extensive coordiunation will be required between NASA, University, Department of State, and when apropriate, selected foreign participants

W83-70486 **656-44-10**
Goddard Space Flight Center, Greenbelt, Md
TRANSPORTABLE APPLICATIONS EXECUTIVE (TAE)
D Helfer 301-344-9425
(656-11-04, 656-30-30 656-26-02)

The objectives of this RTOP are to continue development of a software executive under which new interactive applications data systems may be implemented in an efficient and cost effective manner, and which features (1) the ability to transport multi-source and multi-discipline data and applications software between systems, (2) distributed remote processing within a network of computers, and (3) device-independent imaging and graphics services Under this RTOP, the concepts and software necessary to support a transportable interactive analysis base and techniques for distributed processing with integral catalog management, executive control, communications, and image and graphics processing will be developed, evaluated and demonstrated This RTOP supports the following major programs the severe storms research program, the VAS demonstration project, the LANDSAT-D assessment

system, the networking RTOP, and the atmospheres and climate data management RTOP, and it is expected, the upper atmospheric research satellite The transportable applications executive (TAE) Version 1 will be designed, implemented and distributed to selected sites for field test and evaluation Requirements and design of the TAE remote capability will be completed Applications software will be converted to run under TAE A basic portable imaging and graphics capability will be built and demonstrated A user resource and support office will be supported

W83-70487 **656-50-01**
Goddard Space Flight Center, Greenbelt, Md
IMPROVED ON-LINE AVAILABILITY OF DATA
Joseph H Bredekamp 301-344-8541

The aims are to significantly increase the volume of on-line storage available for interactive scientific data analysis, provide large-volume central data facility for shared use among both central and distributed computers, and facilitate multi-mission correlative studies The approach will be to acquire and integrate a mass storage device in the Science and Applications Computing Center (SACC) This first stage demonstration activity will increase the current on-line storage volume by a factor of 40 Other advancing storage technologies will be investigated General user availbility will be expanded through the sciences directorate local area network (RTOP 656-85-01) Availability will be extended to both on-site Goddard and off-site scientists

W83-70488 **656-60-10**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED TECHNOLOGY IMAGE DIGITIZATION
D A Klinglesmith 301-344-6541

This RTOP is concerned with the development of a high speed digital microdensitometer for use with astronomical imagery The major need for the new microdensitometer results from the increased requirements in photometric precision and overall system throughput The standard astronomical microdensitometer currently in use around the world is capable of digitization at a rate of a few thousand samples per second at low density and only a few hundred samples per second at high densities (above 3 OD) The current photometric precision is in the range of 0 01D Our approach will be twofold First, an effort will be directed at extending the currently accepted machine to its limits This will be done by replacing existing electronics with modern moduals and thereby gain at least a factor of 5 to 10 in speed without any significant decrease in photometric response Second, an effort will be directed at determining the specifications for the next generation high speed astronomical densitometry This will be done by defining the astronomical requirements in terms of image material, photometric precision, system throughput, digital data storage and long term stability

W83-70489 **656-80-01**
Jet Propulsion Laboratory, Pasadena, Calif
PLANETARY DATA NETWORK PROJECT
A L Lane 213-354-7362
(656-31-02 656-13-40)

The objective is to develop a coordinated data management approach for NASA's planetary data sets, and implement a limited number of data processing capabilities at selected institutions to demonstrate and evaluate new data access and processing techniques The planetary data network represents a 5-year computer technology project aimed at improving user access to planetary data from the Voyager, Viking, Pioneer and Mariner missions New computer based capabilities will be implemented at several institutions where there are cognizant planetary scientists working with the data, and at which institutional support is present to sustain the research activity In the planned approach, selected planetary data will be distributed among the participating institutions and will include both image and non-image data types, assembled in compatible digital format, with attribute information available through online catalogs Various computer technologies will be considered, including electronic browsing, graphics, networking, and mass storage on both video disks and digital optical disks The scientists participating in the planetary data network will be responsible for the project design and implementation to insure direct user involvement throughout all phases of project evolution and evaluation A science steering group will be formed to represent the broader science community and to provide feedback on specific approaches planned or executed The capabilities developed will be available to new users as part of NASA's ongoing planetary research program, and will form the baseline system for the storage, achiving and distribution of new planetary data (e g, Voyager/Uranus, Galileo, and future mission)

W83-70490 **656-85-01**
Goddard Space Flight Center, Greenbelt, Md
SCIENCES DIRECTORATE LOCAL AREA COMPUTER NETWORK
William H Mish 301-344-5444

The aim is to permit flexible, and easily distributed computing by tying together computing facilities and peripherals both internal and external to GSFC and specifically to implement a local network of sciences directorate computers using a robust architecture that will permit easy future expansion The initial network to consist of the IBM 3081, VAX 11/780, and a PDP 11/44 The approach will be to (1) compare existing MITRE SNAP' network study with the results of an active sciences directorate study to evaluate other alternative architectures, (2) implement a pilot local area network of the IBM 3081 (Code 603), VAX 11/780 (Code 690) and PDP 11/44 (Code 680) using this architecture, (3) expand this pilot network to include PDP 11/70 (Code 660), NSSDC (Code 601), and additional GSFC computers, and (4) additionally expand the network to include a gateway to remove networks, e g , ARPANET, and computers external to GSFC

W83-70491 **656-90-01**
Goddard Space Flight Center, Greenbelt, Md
GENERAL GROUND SUPPORT EQUIPMENT (GSE) SOFTWARE TECHNOLOGY EXTENSION
Gerald Muckel 301-344-5778

During the past several years, a general purpose software system has been developed to support the integration, testing, and operation of flight scientific instruments The purpose of this RTOP is to further develop this system and to adapt it to recently developed hardware in order to support future NASA missions Specific objectives are to (1) enhance the existing ground support equipment (GSE) software to include graphics support, (2) reduce the amount of computer specific (i e assembly language) software by reorganization of the software and the internal data structures, and (3) increase the effective telemetry data rate handling capability needed to support the processing of large quantities of data in real time The feasibility of including interactive graphics software and hardware in the GSE will be investigated Assuming it is feasible, the procurement for a prototype graphics device will be carried out and implementation of general purpose software to support this activity will be done Reorganization of the data structures used by GSE software will be carried out This will consist of implementing a disk-based data structure in place of the memory resident data structure now in use

Weather and Climate Data Analysis

W83-70492 **672-20-09**
Jet Propulsion Laboratory, Pasadena, Calif
CLOUD PROPERTIES FROM SATELLITE RADIANCES
J P Schieldge 213-354-2046

Algorithms and techniques will be developed to obtain cloud properites from multispectral satellite data sets The main data sets will consist of advanced very high resolution radiometer (AVHRR) radiance measurements from TIROS-N and NOAA-6 satellite flights The data will be analyzed using statistical, pattern recognition, and anaytical methods These methods will be compared with one another to assess their respective advantages and disadvantages This research will support the NASA Climate Research Program's efforts in developing a global cloud climatology

W83-70493 **672-30-00**
Goddard Space Flight Center, Greenbelt, Md
GLOBAL CLIMATE MODEL DEVELOPMENT AND APPLICATIONS
James Hansen 212-678-5619

The objective is to develop and apply climate models to support NASA's role in the National Climate Program, particularly by helping to define observing systems requirements for monitoring analysis and prediction of long-term climate Appropriate climate modeling capability will be developed to conduct numerical experiments including climate process diagnostic studies, with current focus on the role of clouds and solar irradiance variations in the global climate system as well as measurement parameter sensitivity studies and observing system simulation studies

W83-70494 **672-40-00**
Goddard Space Flight Center, Greenbelt, Md
CLIMATE OBSERVATIONS
Otto W Thiele 301-344-9006

The objectives of this RTOP are to (1) study ways of using available satellite data to measure or infer climate parameters (e g , ocean/air heat flux, sea surface temperature soil moisture, etc), (2) evaluate spaceborne techniques for precipitation measurements, (3) participate in preliminary feasibility studies of potential climate space missions with emphasis on the space platform/space station approach, and (4) determine changes in solar size and relate to changes in solar

luminosity which in turn relates to the total energy available to the earth/atmosphere system Transfer functions will be developed to extract climate parameters from visible and infrared sensors on both low and geosynchronous earth orbiting satellites with emphasis on ocean/atmosphere boundary conditions for extending heat flux estimates from coastal regions to the open oceans Instrumentation and sampling options will be investigated for important climate parameters such as global precipitation, surface wind fields, improved sea surface temperature etc , as an integral part of a global environmental and ecology mission adaptable to the space platform/station concept Solar eclipse data will be analyzed and the relationship between radius and luminosity changes will be modelled The solar diameter will be measured directly and model changes will be made in size, shape, and surface temperature to changes in total solar flux

W83-70495 **672-40-08**
Jet Propulsion Laboratory, Pasadena, Calif
SOLAR IRRADIANCE ROCKET EXPERIMENT
R C Willson 213-354-3529

The objectives of the FY-83 solar irradiance rocket program are (1) to provide an inflight reference point for evaluating the long term precision of the 1 A U total solar irradiance records of two satellite solar irradiance monitoring experiments - the Active Cavity Radiometer Irradiance Monitor (ACRIM) on the Solar Maximum Mission (SMM) and the Earth Radiation Budget/HF (ERB/HF) on NIMBUS 7, (2) to advance the state-of-the-art in defining the absolute radiation scale at the total solar irradiance level and (3) to relate these state-of-the-art measurements to user instrumentation Two rocket flights will be conducted in FY-83 using the ACR/ERB/PMO payload developed during FY-82 The first will occur as early in FY-83 as possible to provide a near term reference with the SMM/ACRIM and NIMBUS-7/ERB The last will coincide with the flight of the Spacelab 1 mission for the purpose of transferring the rocket measurement record to the Spacelab ACR and CROM solar irradiance instrumentation at the precision level The ACR and ERB rocket experiments are representative of the SMM/ACRIM and ERB/HF technology and were compared with those experiments The Swiss PMO experiment, provided at no cost, provides an independent measurement capability to aid in evaluating the rocket results Preflight intercomparisons will be conducted between rocket and reference sensors both in air and vacuum at the Solar Testing Facility of JPL s Table Mountain Observatory

W83-70496 **672-50-00**
Goddard Space Flight Center, Greenbelt, Md
CLIMATE PROGRAM SUPPORT
Otto W Thiele 301-344-9006

The objective is to (1) provide program support to NASA Headquarters and Goddard for a broad based NASA climate program which in turn involves a substantial contribution to the National Climate Program, and (2) provide resources for the Climate Program's share of HSVP computing support Recommendations for climate program initiatives are developed in connection with NASA, GSFC climate research Planning support for a global satellite climate data base development is provided, especially a global cloud climatology under the international satellite cloud climatology project Representation to the Climate Information Subgroup of the National Climate Policy Board is provided Planning strategies for physical processes studies are developed with particular emphasis on cloud and earth/atmosphere radiation processes, and support for annual national climate reports to Congress, annual sciences reviews, etc are provided Ad hoc science working groups, advisory panels, etc are arranged for and both in and out of house climate program computing requirements are coordinated Resources provided will be appropriately shared for hardware acquisition, operations, and programming assistance

W83-70497 **672-50-06**
Jet Propulsion Laboratory, Pasadena, Calif
CLIMATE RESEARCH PROGRAM SUPPORT
M T Chahine 213-354-2433

The objective is to provide the Climate Research Program, Environmental Observation Division, NASA Headquarters with program support during FY-83 JPL will provide the services of a member of its scientific staff as a detailee working under the direction of the Manager, Climate Research Program Support will also be supplied in the development and implementation of Climate Research Program plans for the use of remote sensing techniques to study atmospheric and ocean processes as elements of climate research

Stratospheric Monitoring Data Analysis

W83-70498 **673-11-00**
Goddard Space Flight Center, Greenbelt, Md
DASIBI MEASUREMENT OF OZONE PROFILE AND COLUMN-CONTENT
J E Ainsworth 301-344-8256

The objective is to obtain accurate in-situ measurements of atmospheric ozone concentration, column content, and diurnal change in concentration in the region from 0 to 40 km altitude The results will be used to provide verification of satellite measurements used for determining the long term change in the total global ozone, and to provide data necessary for the further refinement of ozone modeling Development and testing of the instruments and procedures necessary for obtaining highly accurate ozone measurements from balloons will be emphasized The instruments comprise a UV photometer of primary standard quality for measuring ozone, along with instruments for accurate measurement of atmospheric and instrument pressures and temperatures Measurements, which are believed the most accurate ones of ozone concentrations presently available for the region from 0 to 40 km altitude, have an estimated maximum error of + or - 3 5% at the ozone maximum and + or - 8 5% at 40 km Column content error is + or - 4 5% Substantial additional reduction of errors is necessary in order to obtain present objectives The goal is to reduce the estimated maximum error in the ozone concentration measurements to 2 2% at 25 km and 4% at 40 km by the end of FY-83 Column content error will be reduce to + or - 3% Note that the above errors, the uncertainty of the ozone absorption coefficient at 253 65 nm contributes an error of + or - 1 5%

W83-70499 **673-13-00**
Goddard Space Flight Center, Greenbelt, Md
INTERCOMPARISON OF DOBSON AND INTERFEROMETRIC SPECTROMETER
C L Parsons 301-928-5390

The standard instrument for ground-based measurements of total atmospheric ozone content is the Dobson spectrophotometer, a double prism spectrometer which uses slits to isolate eight pairs of lines of interest in the wavelength region between 3055 and 3398A It is an antiquated design which uses hardware that is increasingly difficult to maintain, and it is a bulky system that lacks portability Various filter and grating spectrophotometers are being tested by others as potential replacements for the Dobson This project has as its goals the development of a Fourier transform spectrometer prototype system for the study of the advantages and disadvantages of this technique compared to the conventional dispersive spectra approach A system of limited capability has been constructed Hardware improvements are necessary to increase the system's spectral resolution, to add an absolute calibration capability, and to provide graphical data products With these, the prototype Fourier transform spectrometer will be a valuable tool for studying the capabilities of the technique at wavelenghts into the near ultraviolet

W83-70500 **673-14-00**
Goddard Space Flight Center, Greenbelt, Md
AIRCRAFT BORNE LIDAR FOR O3 AND OH MEASUREMENTS
William S Heaps 301-344-5106

The objective is to complete and fly an aircraft borne LIDAR system for the measurement of trace constituents in the troposphere particularly O3 and OH Several engineering flights will be made on board the NASA Electra in an attempt to detect O3, OH and NO It is expected that an operational LIDAR for participation in multispecies field programs will be produced Additionally geophysical data is expected from the initial engineering flights

W83-70501 **673-15-00**
Goddard Space Flight Center, Greenbelt, Md
ABSOLUTE SOLAR FLUX AND VARIABILITY
J E Mentall 301-344-8959

The objective is to measure the solar irradiance outside the Earth's atmosphere over the approximate wavelength range 120 to 400 nm, and to determine the variability of the Sun's UV flux over the period of a solar cycle Using sounding rockets, measurements are made of the solar irradiance over a complete solar cycle Flights are made once or twice per year and satellite measurements are used to correct for the Sun's short term variability Since long term changes in the Sun's output may be on the order of 1% per year, a good deal of attention is paid to the precision of the calibration sources The UV solar flux variability will be determined Ground truth measurements for satellite instruments such as the SBUV instrument on Nimbus 7 and the solar flux experiment on SME will be made, and calibration techniques in the UV will be improved

W83-70502 **673-18-00**
Goddard Space Flight Center, Greenbelt, Md
CORRELATIVE MEASUREMENT IMPROVEMENTS
A C Holland 804-824-3411

The objective is to evaluate and improve correlative measurements made in support of satellite ozone sensors These include (1) the optical rocket ozonesonde (ROCOZ), (2) the balloon-borne electrochemical ozonesonde (ECC) and (3) the meteorological rocket datasonde Studies to automate the acquisition, processing, analysis and distribution of correlative measurement data will be initiated Note the Dobson instrument is addressed in a separate RTOP (673-13-01-30) This effort is in conjunction with the ROCOZ transition plan (March 1982 - March 1983) and addresses tasks not covered there It embraces consolidation, integration, testing, calibration and analysis of ROCOZ hardware and data under one roof at WFC Rational filter characterization methods and validation of same will be developed Absolute payload calibration in conjunction with facilities at GSFC will be established An improved environmental test chamber for testing ECC's under realistic stratospheric conditions will be developed Error sources will be identified and the possibility of generating individual ECC calibration profiles will be investigated Sensor electrochemistry and possible cell modifications aimed at improving high altitude performance, and resolution and precision of high altitude ozone data by shifting to digital data transmission system will also be investigated State-of-the-art techniques exist for modifying the existing U S rocketsonde instrument to provide direct pressure measurements and to reduce or eliminate the radiation error affecting the present bead thermistor

W83-70503 **673-31-00**
Goddard Space Flight Center, Greenbelt, Md
INVESTIGATION OF UPPER ATMOSPHERE DYNAMICS WITH NIMBUS-7 SATELLITE DATA
Kaichi Maeda 301-344-5227

The objective is to analyze and interpret the ozone data with particular emphasis on the semiannual oscillations which might have a connection with well known geomagnetic variations Using a new inversion algorithm (named the Direct Method), which was developed previously under this RTOP, the monthly zonal mean of ozone densities at several altitudes from 30 km up to 60 km in the geographic latitude bands from 80 deg N to 80 deg S will be produced Applying harmonic analysis to these results, the spatial structure of the semiannual oscillation of stratospheric and mesospheric ozone will be obtained Similar variations can be found in the atmospheric temperature and pressure fields from the Nimbus SCR and PMR experiments Separating the variation in the polar regions from the equatorial one, a possible mechanism for these oscillations and connection with geomagnetic activity will be considered Other objectives are to (1) determine the global structure of the semiannual oscillation in atmospheric ozone between 30 km and 60 km from the 1978 to 1981 Nimbus 7 SBUV data, (2) determine the phase variations of these oscillations with altitude from harmonic analysis of data, (3) provide theoretical interpretations of the results, including the cause of hemispheric differences and possible connections with middle atmospheric dynamics and geomagnetic variations

W83-70504 **673-41-00**
Goddard Space Flight Center, Greenbelt, Md
VARIABILITY AND TRENDS IN STRATOSPHERIC OZONE, THE MIDDLE ATMOSPHERE, AND UV SOLAR FLUX VARIATIONS
Donald F Heath 301-344-6421

The objective is to (1) analyze and interpret atmospheric ozone, meteorological and UV solar flux data for the investigation and determination of sources and mechanisms responsible for the natural variability of the middle atmosphere, and investigate secular changes in stratospheric ozone, determine trends and identify anthropogenic and solar related effects, and evaluate the effects and changes in ozone and UV solar flux on the structure and dynamics of the middle atmosphere Through the use of harmonic and trend analysis techniques, long and short term variations of ozone are investigated on a global scale for possible mechanisms which determine the spatial and temporal variability of ozone Variations in UV solar spectral irradiance are studied for information on mechanisms which can produce a variable ultraviolet solar flux input at the top of the atmosphere Existing models of the solar atmosphere are used to study possible solar processes Observed variations in ozone, UV solar flux, atmospheric temperature, winds and structure are evaluated for consistency through existing multidimensional atmospheric models at GSFC

Geodynamics Research and Technology Development

W83-70505 **676-01-01**
Goddard Space Flight Center, Greenbelt, Md
GEODYNAMICS INVESTIGATIONS SUPPORT
J E Welker 301-344-6753

The objective is to provide technical and financial management support to AN's (university grants and private contracts) in the geodynamics discipline The approach is to initiate, monitor and report on research activities conducted for sponsorship of the geodynamics application notice

W83-70506 **676-10-10**
Jet Propulsion Laboratory, Pasadena, Calif
REGIONAL CRUSTAL DEFORMATION
R S Saunders 213-354-3815

The objective of this research is improved understanding of Southern California tectonics from a local scale of individual faults to large-scale strains and block movements The approach is by analytic modeling using a continuum approximation and by two- and three-dimensional finite element modeling Relevant geological and geophysical data will be compiled and evaluated for constraints on the analytic models

W83-70507 **676-30-05**
Jet Propulsion Laboratory, Pasadena, Calif
LITHOSPHERIC STRUCTURE AND EVOLUTION
S F Daly 213-354-4203

The objective of this research is to provide understanding of the properties and structure of the lithosphere and to understand the interaction between the lithosphere and convection in the Earth's mantle Work will continue in the study of gravity and surface topography due to convection in a variable viscosity medium Magma ascent through the lithosphere in the form of diapirs will be studied Numerical techniques will be used to construct quasi-three-dimensional models to study the effect of a moving lithosphere and a subducting slab on the properties of temperature dependent viscosity convection Problems related to the variation of lithosphere properties with depth will be addressed by employing finite element techniques to model motions using the geometric and material property constraints at moving plate boundaries with periodic earthquakes

W83-70508 **676-40-01**
Jet Propulsion Laboratory, Pasadena, Calif
GRAVSAT STUDY
W L Sjogren 213-354-4868

The objective of this effort is to develop a new data reduction technique for producing a gravity field from satellite-to-satellite tracking data as currently proposed for the GRAVSAT Mission The work will be done in collaboration with W M Kaula at UCLA A primary benefit from this task will be significant reductions in the costs of extracting the gravity field

W83-70509 **676-59-10**
Goddard Space Flight Center, Greenbelt, Md
GEOPOTENTIAL RESEARCH MISSION (GRM) GRAVSAT/MAGSAT STUDIES
T Keating 301-344-8613
(676-40-01)

The objectives are to (1) conduct system studies of the Geopotential Research Mission (GRM), (2) investigate magnetometer instability, and (3) develop data processing software to establish benchmark capabilities of the mission designed to measure the Earth's gravity and magnetic fields to an accuracy exceeding the present capability System studies will determine the complex relationship of the Doppler tracking, the DISCOS, the propulsion, and the magnetometer boom Investigation of the lamp instability of the magnetometer will be performed Software conversion from the IBM 360 machines to the Cyber 205 will be continued The studies and software conversion will yield benchmark results that will allow project definition assuring successful measurement of the Earth's gravity and magnetic fields

W83-70510 **676-59-30**
Jet Propulsion Laboratory, Pasadena, Calif
SERIES - SATELLITE EMISSION RANGE INFERRED EARTH SURVEYING
L E Young 213-354-5018

The objective of this RTOP is threefold The first is to demonstrate the current SERIES technology as a practical, cost effective conventional

geodetic tool The second is to bring the technology to the point where it is ready for implementation in a Caribbean basin cooperative geodetic program The third objective is to demonstrate a remote automatic geodetic monitoring system The current SERIES system makes use of the characteristics of the C/A and P codes of the Global Positioning System (GPS) satellites to deduce differenced GPS ranges to a ground network of receivers, without requiring knowledge of the GPS codes Simultaneous measurements of the ionospheric delays are also made within the SERIES receivers Performance of the current SERIES technology in measuring baselines will be verified over known baselines The system will be made ready for implementation as a tool for regional geodesy by demonstration of the ability to remove GPS orbit uncertainties from the baseline solutions and by removing the need for a steerable antenna For a remote geodetic monitoring system, the capability for remote control and long term unattended operation will be added to the SERIES receivers

W83-70511 **676-59-33**
Marshall Space Flight Center, Huntsville, Ala
SUPERCONDUCTING GRAVITY GRADIOMETER
Eugene W Urban 205-453-5132

The objective of this RTOP is to demonstrate the feasibility of a three-axis superconducting gravity gradiometer for space flight that is capable of measuring gravity gradients along three mutually perpendicular axes with a sensitivity of 0 01 EU or better A single-axis unit will be completed and tested, and a three-axis engineering unit will be designed, fabricated, tested, and refurbished for a possible Shuttle test flight

W83-70512 **676-59-41**
Marshall Space Flight Center, Huntsville, Ala
SHUTTLE TIME AND FREQUENCY TRANSFER EXPERIMENT (STIFT)
R Decher 205-453-5130

The objective of this RTOP is to define a demonstration experiment using a Hydrogen Maser Clock onboard the Shuttle for global, high-accuracy time and frequency transfer Microwave and laser signals will be transmitted between the space vehicle and ground stations to compare the space-borne clock with ground-based clocks Accuracy of frequency transfers in the order of one part in 10 to the 14th power, and time synchronization to within 1 nanosecond, are to be demonstrated

Resource Observation Applied Research and Data Analysis

W83-70513 **677-21-24**
Goddard Space Flight Center, Greenbelt, Md
RENEWABLE RESOURCES FIELD RESEARCH AND SPACECRAFT DATA ANALYSIS
Robert E Murphy 301-344-7282

The overall objective is to develop and apply data interpretation techniques to the study of renewable resources problems Particular emphasis is placed on techniques which utilize data from instruments with resolutions which are either higher or lower than the standard multispectral scanner (MSS) resolution of 80 meters (High spatial resolution studies are in support of the thematic mapper and future systems such as the multispectral linear array Low resolution studies are in support of observing systems such as the advanced very high resolution radiometer on the NOAA satellites) Additional subobjectives include development of analytical techniques and instruments for ground truth measurements and the establishment of field measurement data sets Data sets consisting of existing geographical data, field measurements under controlled conditions and aircraft data are acquired and compared with spacebased data as appropriate to assess land cover status, land use practices The impact of various instrument parameters on determining land cover status etc is assessed Algorithms for analyzing these data are adapted or developed

W83-70514 **677-21-25**
Jet Propulsion Laboratory, Pasadena, Calif
LAND COVER MULTISENSOR ANALYSIS
N A Bryant 213-354-7236

It is the purpose of this task to advance the state-of-the-art of resource management analysis and planning activities by developing software and procedures that integrate and interpret a variety of remotely sensed data types (visible, SWIR, SAR) and collateral data to analyse land cover in urban/suburban regions It is expected that the products of this research will help NASA focus upon the more pertinent parameter requirements for geometric and classification accuracy on future missions and associated SRT areas in land resources Improvements in the capability to map and integrate remotely sensed data into land resources data bases are being pursued by (1) developing procedures and software which integrate remotely sensed data with other collateral data into models which assess potential land capability under varying constraints to land use, (2) developing in FY-81 and supporting in FY-82 the analysis of research data sets of the Los Angeles area composed of registered multi-frequency, multi-temporal and multi-sensor data sets in conjunction with National Science Foundation research sponsorship, (3) continuing the analysis of SAR responses to land cover mapping by incorporating scatterometer measurements and modelling reflectance properties of Los Angeles area urban and near-urban land cover types, (4) determining the incremental improvements in urban land cover classification accuracy achievable from a registered set of specified sensors for each level cover type identification, and subsequently merging the stratified classifications, and (5) testing and evaluating the environmental improvement achieved by the TM over MSS in land cover classification using simultaneous MSS and TM acquisitions from LANDSAT-D (ER-2 overflight and MSS acquisition backup if required) Each of the development areas will make use of airborne, high-resolution digital data where available Emphasis will be upon the integration of the future satellite image simulations and ancillary data to test the improvement potential for land resources mapping

W83-70515 **677-21-26**
Ames Research Center, Moffett Field, Calif
THEMATIC MAPPER SIMULATOR LAND RESOURCES STUDIES IN WESTERN ECOZONES
R C Wrigley 415-965-6060
(677-21-25)

The objectives are to evaluate the impact of thematic mapper (TM) data on classification accuracy and resource identification in Western ecozones, and evaluate TM as one stage, along with LANDSAT Multispectral Scanner (MSS), in a multistage sampling approach for the inventory and mapping of irrigated croplands and major crops over arid and semi-arid regions of the West The approach will be to acquire ground, TM or thematic mapper simulator (TMS), and LANDSAT MSS data sets for forest, urban and agricultural regions in California Classification accuracy will be evaluated as a function of sensors, the analysis process employed, and the level of thematic information extracted using a standard contingency table approach to performance evaluation Existing clustering and classification algorithms from in-hand software systems will be evaluated in terms of their ability to handle TMS data The spectral and spatial information content of TMS data will be assessed through the examination of measured irradiance values, textural transforms and statistical separability measures A technique for selecting optimal TMS waveband combinations for variable resource mapping tasks will be developed using statistical separability measures Texture measures will be examined as a classification tool For Western agricultural applications, classification accuracy vs cost factors will be used to evaluate TM/TMS data as (1) a single resource, (2) combined with sampled ground data, (3) combined with MSS, and (4), as a part of a total ground/TM/TMS system design

W83-70516 **677-21-28**
National Space Technology Labs , Bay Saint Louis, Miss
MULTISENSOR TECHNIQUE DEVELOPMENT
E F Zetka 601-688-3830

The objective is to conduct research, utilizing a number of different sensors and analysis methods, to determine basic remote sensing factors/parameters associated with land surface cover, and develop techniques to better discriminate and delineate those land cover forms The RTOP is comprised of four tasks (1) utilize the airborne thermal infrared multispectral scanner to obtain and analyze the quantitive measurement of surface vegetation temperature in the 8 to 12 micron region, and examine D-thematic mapper (TM) mid-IR channels for vegetation water content characteristics, (2) analyze Shuttle imaging radar-A data over an Alabama study site to determine which basic physical and/or biological properties of land cover have the most effect on microwave radar return, (3) evaluate quantitative statistical approaches to reduce the data channel dimensionality of soon to be acquired TM data, and (4) determine the contribution new wavelength regions (e g , 1 55 to 2 35 m) will have on the analysis of natural plant communities, as well as in non-natural vegetated areas, under stressed conditions

W83-70517 **677-21-29**
National Space Technology Labs , Bay Saint Louis, Miss
LAND RESOURCES APPLIED RESEARCH
Armond T Joyce 601-688-3830

The general objective is to develop new and/or improved techniques to increase the accuracy and/or information about land resources that can be derived from remotely sensed data This general objective is addressed through four specific applied research tasks which correspond

to the following objectives (1) develop and test technique using remotely sensed data to monitor and assess the degradation process and its indicators in semi-arid areas, and to develop and apply predictive models of degradation processes (2) determine and evaluate what information pertinent to the discrimination of surface mines as small, heterogeneous features can be derived from present and future space-acquired data, (3) develop remote sensing techniques capable of delineating soils in a manner which would serve to expedite the preparation of highter order soils surveys, and (4) conduct and coordinate NASA remote sensing research with selected National Science Foundation long-term ecological research projects All four objectives will be pursued using thematic mapper (TM) simulator, LANDSAT TM, and LANDSAT multispectral scanner data In addition synthetic aperture radar and thermal infrared multichannel scanner data will be brought to bear on the second and fourth objectives

W83-70518 **677-21-30**
Lyndon B Johnson Space Center, Houston, Tex
LAND USE AND TECHNIQUES FOR MONITORING LARGE SCALE CHANGE IN BIOMASS
M C Trichel 713-483-6451

The objectives are to (1) develop and evaluate remote sensing oriented strategies for sampling and aggregation which support regional and global scale inventories of surface biota and monitoring of their change through time, (2) develop and evaluate remote sensing technologies which support regional and global scale inventories of surface biota, and(3) develop and evaluate remote sensing technologies which support regional and global scale monitoring of change in surface biota The basic technical approach will be to develop remote sensing technology tools and a general technological framework for regional and global remote sensing of surface cover particularly vegetation The strategy will be to develop remote sensing information extraction tools for detecting and quantifying the state of the global environment with minimal ground data collection requirements while pursuing a more detailed understanding of the more specific information needs and levels of detail Since a major indicator of the ecological transformation processes which occur in an area is that due to changes in general land use characteristics, emphasis will be given to the development and testing of sampling and estimation strategies for detecting and estimating these land use changes

W83-70519 **677-22-27**
Goddard Space Flight Center, Greenbelt, Md
HYDROLOGIC INFORMATION EXTRACTION TECHNIQUE DEVELOPMENT
A Rango 301-344-5480
(677-29-05)

The objectives are to (1) develop and test snowmelt runoff estimation and snowpack properties monitoring techniques in support of the U S /Japan research project and evaluate models in domestic and foreign basins (2) develop and test remote sensing evapotranspiration techniques in support of the U S /Japan research project, (3) use microwave techniques to develop a method for determining the hydraulic conductivity of soils, and (4) develop techniques for measuring watershed physiography with thematic mapper type data for input to hydrologic models The approach will be to exchange models and data and conduct joint analysis and reporting of snowmelt runoff modeling and snowpack characterization with Japanese co-investigators, and evaluate snowmelt runoff model simulations by comparing predicted versus measured flows Howard University will test satellite capabilities in Himalayas Energy balance models and satellite data will be exchanged with Japanese co-investigators and tested using surface temperature and soil moisture information Microwave-based models for estimating hydraulic conductivity of soils will be developed and validated with data from sites in Maryland and Texas The TMS thematic mapper capabilities for extracting watershed features over basins previously mapped with MSS data will be assessed

W83-70520 **677-27-01**
Goddard Space Flight Center, Greenbelt, Md
MULTISPECTRAL LINEAR ARRAY FOR REMOTE SENSING
W L Barnes 301-344-8117
(677-29-06, 677-26-14)

The objectives are to demonstrate the required multispectral linear array focal plane technology for resource observations in the visible/near infrared (VIS/NIR), shortwave infrared (SWIR) and thermal infrared (TIR) spectral regions, to develop a science basis for system performance criteria and to develop associated pacing technologies To develop the SWIR focal plane, two contracts will be awarded for a forty-two month development program During the first phase, each contractor will demonstrate a SWIR module as the basic building block of the focal plane The second phase will develop a fully populated focal plane Supporting science and engineering studies will be continued to develop a science basis for system performance parameters and to advance associated pacing technologies in the areas of passive radiative coolers, optics, calibration, photovoltaic TIR arrays, monolithic SWIR technology, VIS/NIR focal plane development and data processing trades This RTOP supports LANDSAT, Shuttle payloads, and an advanced land observing system These in turn support the following objectives (1) renewable and nonrenewable resource observations, (2) environmental observations, and (3) disaster assessment

W83-70521 **677-29-05**
Goddard Space Flight Center, Greenbelt, Md
SOIL/SNOW MOISTURE RESEARCH AND ASSESSMENT MISSION STUDY
Harry Montgomery 301-344-8033

The objective is to define mission requirements, instrument options, and feasible system concepts for a soil/snow moisture research and assessment mission that can be adapted to the Shuttle or the future space platform/station The recently formed science working group will define and evaluate the requirements for satellite remote sensing measurements of soil and snow moisture A study of various instrument options that are responsive to those measurement requirements will then be made to form the basis of the study of feasible system concepts The results of these system concept studies will be iterated with the working group to assure compliance with the requirements The space Shuttle and space platform/station will be considered as possible alternatives The need, if any, for new technology to support the mission will be research programs of NASA and other agencies User needs, mission requirements instrument configuration, system concepts and required new technology will be documented

W83-70522 **677-29-12**
Jet Propulsion Laboratory, Pasadena, Calif
DIGITAL TOPOGRAPHIC MAPPING MISSION REQUIREMENTS/ FEASIBILITY STUDY
M Kobric 213-354-4631

The overall objectives are a determination of the requirements for digital topographic mapping of the Earth, and a definition of the sensors needed to achieve such a capability during an orbital mission An evaluation of the various sensors and techniques available for digital mapping will be performed These include, but are not limited to (1) photographic stereo, (2) synthetic aperture radar stereo, (3) multi-spectral stereo (radar-photo hybrid), (4) radar altimetry, (5) synthetic aperture radar interferometry, and (6) scanning laser altimetry Error and efficiency analyses will be performed for each of these, and new technology requirements will be identified A users working group comprised of individuals representing a cross section of universities, industrial and government agencies will develop a set of requirements for a digital topographic mapping mission This group will specify scientific requirements such as horizontal and vertical resolution, swath width or areal coverage identification of high priority targets, overlap with LANDSAT/ other data bases, data products and data processing and distribution In light of the recommendations of the UWG and technical results of the sensor studies, a candidate design for a first topographic mapping mission will be identified The parameters to be specified include sensor type and configuration, orbit parameters, mission length, data processing and product requirements, orbital platform and the implementation of a data processing and distribution system

W83-70523 **677-29-12**
Jet Propulsion Laboratory, Pasadena, Calif
DIGITAL TOPOGRAPHIC MAPPING MISSION REQUIREMENTS/ FEASIBILITY STUDY
M Kobrick 213-354-4631

The overall objectives are a determination of the requirements for digital topographic mapping of the Earth, and a definition of the sensors needed to achieve such a capability during an orbital mission An evaluation of the various sensors and techniques available for digital mapping will be performed These include, but are not limited to (1) photograhic stereo, (2) synthetic aperture radar stereo, (3) multi-spectral stereo (radar-photo hybrid), (4) radar altimetry, (5) synthetic aperture radar interferometry, and (6) scanning laser altimetry Error and efficiency analyses will be performed for each of these, and new technology requirements will be identified A users working group comprised of individuals representing a cross section of universities, industrial and government agencies will develop a set of requirements for a digital topographic mapping mission This group will specify scientific requirements such as horizontal and vertical resolution, swath width or areal coverage identification of high priority targets, overlap with LANDSAT/ other data bases, data products and data processing and distribution In light of the recommendations of the UWG and technical results of the sensor studies, a candidate design for a first topograhic mapping misson will be identified The parameters to be specified include sensor

type and configuration, orbit parameters, mission length, data processing and product requirements, orbital platform and the implementation of a data processing and distribution system

W83-70524 **677-29-14**
Jet Propulsion Laboratory, Pasadena, Calif
SPACE STATION RESOURCE OBSERVATIONS PAYLOAD STUDY
J B Cimino 213-354-4631

The objectives are to (1) define a concept for utilizing advanced sensor systems on space station missions for Earth Resources investigations, (2) determine the mission requirements within the framework of anticipated space station engineering capabilities, (3) define a set of synergistic instrument complements to satisfy scientific requirements for selected experimental missions, and (4) provide guidance for the evolving design to assure maximum science output The results of this study for FY-82 are based on a set of science discipline objectives in the area of Earth resources for which a space station could be utilized Specific mission requirements to be studied include orbits (altitudes and inclinations), observation cycles, experimental lifetime, spectral bands, and spectral and spatial resolutions Three experimental payloads were chosen and operating modes (instrument integration, observation cycle, data acquisition, etc) were investigated Inasmuch as these studies are based on the Marshall Space Platform concept, the mission requirements defined will require revision as the space station concept itself is redefined or refined It is important that the Earth and Planetary Exploration Division office has a plan for the use of the space station and understands its advantages and disadvantages if it is to be a potential user

W83-70525 **677-29-17**
Jet Propulsion Laboratory, Pasadena, Calif
ATTITUDE TRACKER FEASIBILITY STUDY
F C Billingsley 213-354-2325

Line array sensors produce data which has no inherent geometrical continuity, hence, any platform attitude variation will be evidenced as a distortion when the data lines are displayed in the normal Cartesian raster Ancillary sensing is required to establish the platform attitude to allow geometric rectification This is normally provided by inertial or star reference attitude sensors In the absence of such sensors or if performance of them is degraded, the required attitude information is lost A strawman sensor design is proposed which utilizes small image areas on the ground to provide a series of motion vectors with which the platform attitude can be tracked, this allows the distorted image received by the normal image line sensor to be rectified The first year work is a theoretical study leading to a potential set of parameters for later implementation It will be accompanied by a simulation using MSS or TM data If the theoretical study so indicates, the simulation will be followed by a photographic mock-up using geometry more close to the eventual configuration, and later an all-electronic prototype system These will occur after the first year

W83-70526 **677-29-18**
Jet Propulsion Laboratory, Pasadena, Calif
ADVANCED RADAR CONCEPTS AND SYSTEMS STUDY
F K Li 213-354-2849

While the presently planned spaceborne active microwave experiments, such as SIR-B and SAMEX, will provide essential radar measurements, they will not provide complete measurements of the target radar signatures as a function of frequency In addition, other interesting features, such as target altitude, will not be obtained by these systems The objective of this RTOP is to perform preliminary system design studies for several advanced radar systems that will provide information complementary to the planned systems Most of these advanced systems will be designed to operate on the Shuttle The performance of these systems will be evaluated by analysis and computer simulation Any technology development that is critical to the implementation of these designs will be identified In each fiscal year, two to three advanced radar system concepts will be selected for study System designs that meet the requirements identified by the scientific communities will be formulated The expected results are documents summarizing these designs These documents can then serve as initial guidelines for future mission studies In FY-83, three specific radar systems will be studied (1) an imaging radar spectrometer which can provide high resolution imagery at a multitude of frequencies, (2) an interferometric SAR system that can generate altitude information for every pixel in an image and (3) a medium resolution radar operating at the frequency range of 30-40 GHz

W83-70527 **677-29-22**
Jet Propulsion Laboratory, Pasadena, Calif
LUMINESCENCE DETECTOR FROM SPACE
James B Breckinridge 213-354-6785

The objectives are to verify that a technique based on luminescence in the Fraunhofer lines is useful for distinguishing material from orbital distances, investigate the applicability of radiation in other absorption lines, and develop a design approach for an optical system for remote sensing of luminescence using Fraunhofer lines Laboratory experimentation on geological material and standard phosphors will be carried out using available spectrometers to determine luminescent spectra and efficiencies Excitation spectra typical of solar radiation at the Earth's surface will be employed Standard phosphors can be expected to place upper limit on expected differences under these conditions Some field samples will be analyzed using laboratory technique to determine luminescent components and dilution levels expected in practice Building on this experience, the efficacy of this method for use in orbiting Earth observations will be verified Quantitative luminescence efficiency measurements will be used to calculate more accurate signal-to-noise ratios and probabilities for detection Optical systems engineering skills will be applied to detail a design approach, selecting among imaging spectrometers If available, an imaging spectrometer will be used to record a picture of geological features luminescing in Fraunhofer lines Atmospheric effects on the SNR will be examined

W83-70528 **677-29-23**
Goddard Space Flight Center, Greenbelt, Md
LONG WAVELENGTH SUBSURFACE SOUNDER
J D Oberholtzer 804-824-3411

The objective of this RTOP is the development of an electromagnetic system capable of remotely performing a geological subsurface sounding The requirements, concepts, and critical technologies must be defined for this development A multifrequency electromagnetic signal is transmitted into the Earth, and the signal scattered back into the detectors is analyzed to detect conductivity anomalies The variation of signal penetration with frequency provides a depth measurement The necessary operating characteristics of the instrument are to be identified for use on platforms at the highest practicable altitudes During the course of this RTOP, as technological barriers appear that might limit the development of this system, the critical needs for further research and development will be identified

W83-70529 **677-41-03**
Jet Propulsion Laboratory, Pasadena, Calif
IMPROVED ROCK TYPE DISCRIMINATION
A B Kahle 213-354-7265
(677-41-22, 677-41-23, 677-41-14, 677-41-16, 677-41-17, 677-41-19)

The objective of this program is to develop an improved capability to discriminate among rock materials (rocks and rock weathering products, including soils) using remote sensing techniques to infer composition, mineralogy and litholoy from spectral reflectance and emittance properties in the 0 4 microns to 14 microns spectral region The approach is to acquire data in the 0 4 microns to 14 microns region of the spectrum in the laboratory, on the ground, from aircraft, and from satellites Existing field instruments will be used in a continuing effort to determine the influence of variable environmental conditions (e g , soil moisture, vegetation, atmospheric water vapor) upon remotely sensed data Trade-offs among spatial resolution, spectral resolution, and radiometric precision will be evaluated in terms of effects on discriminability of common rock types Data analysis techniques will be developed as required Specific topics to be studied include (1) evaluation of data acquired during FY-82 in visible-near infrared wavelengths over sites in the Sierra Nevada batholith, the Idaho batholith, Mountain Pass, and other regions, (2) selection and analysis of a new geologic area using combined data sets from the three NASA thematic mapper simulators (TMS), and the thermal infrared multispectral scanner, the high spectral resolution airbone imaging spectrometer, and also the thematic mapper if data are available, (3) analysis of in situ emissivity measurements obtained with the portable field emission spectrometer during the 1982 field season, and comparison with laboratory measurements performed on field samples under controlled conditions (4) evaluation of the sensitivity and radiometric precision of the three NASA TMS, and a systematic study of the effects of spatial resolution on the geologic utility of multispectral images, (5) continued compilation, documentation, and publication of the large spectral data base, now containing many thousands of field spectra, and (6) continued evaluation of the utility of thermal inertia data for geologic applications, as determined from aircraft, HCMM, and field instrument data

W83-70530 **677-41-13**
National Space Technology Labs , Bay Saint Louis, Miss
HYDROTHERMAL ORE SYSTEM DETECTION IN PARTIALLY VEGETATED, MOUNTAINOUS TERRAIN
D L Rickman 601-688-3830

It will be the purpose of this project to determine the utility of

thematic mapper data (initially through simulation) in the detection and mapping of hydrothermally altered characteristics of specific ore systems in extremely rugged terrain and mixed degrees of vegetative cover A second objective will be to use the data for lithologic mapping Supporting both objectives, TM(S) data will be integrated with other geologic data sets and evaluated for their utility as a coherent whole Thematic mapper simulator data has been acquired over the Mt Emmons, Colorado, molybdenum ore body and the mountainous adjacent areas Topographic effects are expected to be significant in all subsets of the data The data will be integrated with digital elevation and, if available, geochemical and geophysical information supplied in part by AMAX, Inc Areas of total, mixed, and zero vegetative cover will be separated and processed independently using different techniques In areas of total vegetative cover, the distribution of flora will be modelled in terms of elevation and aspect with a 'geology' residual and then computed Barren areas will be treated by band ratioing and canonical analysis Upon completion of the separate processing, the subsets will then be recombined The primary computer products should be lithology, alteration, and vegetation maps for the area These will be analyzed for the utility of TM-type data under these conditions in providing significant geological information

W83-70531 **677-41-14**
Jet Propulsion Laboratory, Pasadena, Calif
HIGH SPECTRAL RESOLUTION TECHNIQUES FOR GEOLOGIC MAPPING
A F H Goetz 213-354-3254
(677-41-03, 677-41-77)

This work addresses one part of a continuing program at JPL to advance the state-of-the-art in geologic remote sensing The overall objective of this program is to develop methods of discriminating among and identifying geological materials on the basis of their composition, mineralogy, and lithology through the use of narrow-band multispectral remote sensing measurements in the visible and infrared wavelength regions of the electromagnetic spectrum Three new instruments will be used to facilitate research in high-resolution remote sensing (1) During the latter part of FY-82, the thermal infrared multispectral scanner (TIMS) will have been completed and calibrated at JPL In addition, test flights over the Tintic, Utah site will have been completed These tests will be analyzed and the important TIMS instrument parameters will be characterized The results will be documented and published (2) In FY-82, the airborne imaging spectrometer (AIS) will be completed and initial testing begun The AIS will provide 128 spectral channels in the 1 2-2 4 micrometer region for each of 32 spatial channels across the flight track In FY-83 initial testing will be completed on a Dryden DC-3 and thereafter the instrument integrated into the C-130 platform (3) A new instrument, the portable instant display and analysis spectrometer (PIDAS) will be constructed and tested Two versions of this instrument will eventually be fabricated, one for the 0 4-1 1 micrometer region and one for the 1-2 5 micrometer region

W83-70532 **677-41-16**
Jet Propulsion Laboratory, Pasadena, Calif
OIL AND GAS TEST CASE STUDY
H R Lang 213-354-3440
(677-41-03, 677-41-14, 677-41-18, 677-41-04, 677-48-03 677-80-19)

The primary objectives are to (1) demonstrate that useful information for geologic/geobotanical mapping can be obtained through the analysis of data acquired by state-of-the-art remote sensing techniques, (2) evaluate the utility of current remote sensing technology for geologic mapping of a known oil and gas occurrence characterized by hydrocarbon seepage, and (3) develop recommendation for the design of aircraft/spacecraft remote sensing systems that could supply data to meet the information requirements of economic geologists involved in oil and gas exploration The general approach is to continue the ongoing investigation of the Lost River, West Virginia test site, including the enlarged regional study of the south-central Appalachians in order to evaluate the cause of cross-strike structural discontinuities which may have a controlling influence on the surface expression of underlying oil and gas reservoirs Geobotanical studies will be continued within the test site for the purposes of enhanced geologic mapping and the evaluation of potential seepage induced geobotanical anomalies The investigation of oil and gas seepage phenomena associated with the Pico anticline oil and gas field area of southern California will continue

W83-70533 **677-41-17**
Jet Propulsion Laboratory, Pasadena, Calif
CHROMITE TEST CASE STUDY
M J Abrams 213-354-6927
(677-42-05)

The main objective of this study is to evaluate the utility of remote sensing techniques for geologic mapping in areas of known chromite and nickel occurrences Other objectives are to (1) determine the ability to discriminate various ultramafic rock types, (2) study the association of vegetation species/communities with rock type, and (3) identify possible vegetation anomalies due to substrate chemistry The test site area is located in northern California/southern Oregon in the Josephine Ophiolite Complex Mineral deposits are associated with ultramafic rocks which consist of dunite wehrlite, harzburgite, and serpentinite The site has moderate relief, and vegetation cover varies from 20 to 30% to 100% Further computer image processing at JPL's image processing laboratory will be performed on the two aircraft multispectral scanner data sets obtained during FY-82 and data to be acquired in October, 1982 The NS-001 thematic mapper simulator (TMS) data and MSS 11-channel data will be co-registered to a topographic base Geologic maps will be digitized and registered to the same base This combined data set will provide the remote sensing data which will be examined for geologic and geobotanical information related to rock type discrimination and vegetation mapping The TMS aircraft data will be compared and contrasted with LANDSAT-D thematic mapper data if data is available during FY-83 Further field work will be undertaken to verify results from the analysis and interpretation activities Anomalous areas will be visited to determine the cause of the image features Field reflectance measurements will be obtained where necessary to supplement existing data Work will continue to be done in cooperation with Dr D Mouat at ARC and Dr M Podwysocki of the US Geological Survey, Reston Data exchange and synthesis of results in adjoining areas will allow a more regional study to be performed, without duplication of efforts

W83-70534 **677-41-19**
Jet Propulsion Laboratory, Pasadena, Calif
SMIRR DATA ANALYSIS
A F H Goetz 213-354-3254

The objective of this effort is to continue to analyze, interpret and make ground checks on the data from the Shuttle multispectral infrared radiometer (SMIRR) flown on STS-2, November 12 to 14 1982 The results of the analysis will be used to determine whether the 10 chosen spectral bands, spanning 0 5 to 2 35 microns can be used for the identification of surface materials worldwide Special attention will be paid to areas covered by vegetation to gain information on the response of vegetation in narrow spectral bands beyond 1 micron Preliminary analysis of SMIRR data has shown that location of the radiometer field of view is accurate, the atmospheric transmission can be obtained by obtaining laboratory spectra of uniform areas covered by SMIRR, and clay and carbonate minerals can be identified in the orbital data Further work will concentrate on obtaining ground measurements in key areas and measuring the extent of atmospheric interference to direct identification of surface materials, and analysis of areas 100% covered by vegetation Work will be carried out in conjunction with Dr Lawrence Rowan of the USGS

W83-70535 **677-41-23**
Jet Propulsion Laboratory, Pasadena, Calif
GEOLOGICAL APPLICATIONS OF NEW REMOTE SENSING TECHNIQUES
A B Kahle 213-354-7265
(677-41-03)

The overall objective of this RTOP is to evaluate new types of measurement techniques for geological remote sensing We will investigate the measurement capabilities of new technology, obtain experimental data as required, and evaluate the potential utility of new technology for geological applications This will involve advanced studies of laboratory, field, and airborne instruments that could be fabricated in the future Two activities will be undertaken this year, a test of active laser remote sensing and a design study for a field luminescence spectrometer We will evaluate the utility of laser reflectance measurements in the thermal infrared portion of the electromagnetic spectrum Experimental airborne data will be collected using an existing JPL CO2 laser over suitable different types of rocks and soils can be detected in laser reflectance measurements will be determined A design study will be undertaken for a portable multispectral luminescence spectrometer that could be easily deployed in the field to measure solar stimulated luminescence within narrow wavelength bands in which natural solar radiation is reduced (i e , so called Fraunhofer lines) The field device should be able to obtain spectral measurements at several different wavelengths in the visible and possibly the ultraviolet A detailed cost plan for the actual fabrication of this instrument will be developed

W83-70536 **677-42-04**
National Space Technology Labs, Bay Saint Louis, Miss
USE OF TM FOR THE DETECTION OF MINERALIZATION IN VEGETATED TERRAIN THROUGH INFERENCE OF GEOBOTANICAL PARAMETERS
W G Cibula 601-688-3830
(677-41-13)

The objective is to develop and evaluate practical techniques for using the thematic mapper (initially through simulation) and other air and spaceborne systems for geobotanical mapping The emphasis will be on ore bearing terrains in areas which are moderately to heavily vegetated Geobotanical methods involve the use of surface vegetation to help identify the nature and properties of the substrate The two aspects that are believed to be identified by remote sensing means are differences in plant community structure, and the effects of mineral stress in the plant community Data processing will include the development of spectral pattern recognition outputs, since pattern recognition is effective in emphasizing minute detail in spectral data and therefore is capable of finding subtle geobotanical relationships Field verification of results is central to the project Concurrently, geological data from other sources will be obtained and compared to the spectral data map products

W83-70537 **677-42-05**
Ames Research Center, Moffett Field, Calif
REMOTE SENSING TECHNIQUES FOR GEOBOTANICAL DISCRIMINATION OF CHROMIUM-BEARING ROCK TYPES
D A Mouat 415-965-5896
(677-41-77, 677-42-01, 677-42-04)

The primary objective of this RTOP is to develop and evaluate techniques using remote sensing technology to discriminate parent materials associated with known chromite deposits using vegetation characteristics These techniques are needed to improve rock type discrimination and mineral exploration Immediate objectives include an assessment of sensors, analytical techniques, appropriate vegetation parameters, and the degree to which selected terrain features improve vegetation based techniques An accuracy and efficiency comparison will be performed The approach will consist of several facets A study area and test sites will be selected so as to include chromium-bearing ultramafic rocks from the western belts of the Klamath Mountains in southwest Oregon The vegetation and terrain features will be examined and described in order to discriminate those parent materials Aerial photography and thematic mapper simulator data will be acquired over the test sites A second study area will be selected in an area of serpentine rock types in northern California In that area Shuttle imaging radar-A imagery will be examined in order to differentiate serpentine rock types and associated mineralization on the basis of the associated vegetation In both areas, several analytical techniques will be employed in the data reduction phase

W83-70538 **677-42-07**
Goddard Space Flight Center, Greenbelt, Md
GEOBOTANICAL MAPPING IN THE EASTERN UNITED STATES
E J Masuoka 301-344-5600
(677-42-01)

The objective is to evaluate the combined utility of state-of-the-art remote sensing techniques for geologic mapping in areas of moderate to dense natural vegetation The approach will be to (1) select two regional test sites in the Applachian Plateau, Blue Ridge and Valley and Ridge which cover approximately 100 x 100 km, (2) compile orbital data previously collected over the test sites including LANDSAT, HCMM and SEASAT SAR, (3) register orbital data, geologic, botanical and geophysical map data to a topographic base, (4) analyze the combined data to determine the success rate for mapping specific geologic features under different combinations of season and physiographic province, (5) select 10 x 10 km test sites in each regional site that encompass several lithologies, have moderate to dense vegetation and possess geologic features which were recognized in the orbital data (6) collect thematic mapper simulator and thermal infrared multispectral data over the test sites at several points in the year concentrating primarily on the start of the growing season and leaf senescence, (7) collect detailed botanical, geologic and soil series observations at each site, (8) analyze the remotely sensed and ground truth data to assess the benefits derived by increased spectral and spatial resolution in the thermal infrared and quantify relationships between lithologic, soil, botanical and remote sensing variables in geobotanical mapping and (9) combine results from test sites at both scales to assess the potential for augmenting or replacing conventional ground based information with airborne and orbital data in the exploration process

W83-70539 **677-43-16**
Jet Propulsion Laboratory, Pasadena, Calif
USE OF SAR FOR GEOLOGIC MAPPING
J P Ford 213-354-6735
(677-46-02 677-43-17)

SEASAT synthetic aperture radar (SAR) provided the first spaceborne radar images of the Earth for scientific applications in 1978 The images were acquired with a 20 deg incidence angle over most of North America, and parts of the Caribbean and western Europe The Shuttle provided a second generation of spaceborne SAR images in 1981 The images were acquired with a 50 deg incidence angle over selected portions of each continent except Antarctica The objectives of this RTOP are to analyze the data from the SEASAT and the Shuttle Imaging Radar (SIR-A) missions, to evaluate the utility of imaging radar data for purposes of geologic mapping and interpretation in different selected geologic/geomorphic environments and to utilize the findings in support of experiments in geologic mapping to be performed with SIR-B This evaluation includes the use of airborne SAR images, scatterometer data and corresponding coverage with spaceborne sensors in the optical and near infrared range of the EM spectrum for comparative purposes This proposal covers the three year period from FY-83 to FY-85 It represents the efforts of five researchers with the common objective of understanding the geologic and topographic information in SAR images, in conjunction with other remote sensing data, for applications in geologic mapping and interpretations The approach is to conduct detailed studies of specific sites through a range of climatic environments from arctic through temperate to tropical, in regions that range from arid to humid Emphasis will be placed on tropical regions and areas of extensive vegetation cover Quantitative measurements of feature perception relative to imaging geometry on SEASAT and SIR-A images will be used to determine the most desirable range of illumination conditions for the acquisition of corresponding coverage with the variable look angle and repetitive coverage capability of the SIR-B system

W83-70540 **677-43-17**
Jet Propulsion Laboratory, Pasadena, Calif
TOPOGRAPHIC MAPPING METHODS
M Kobrick 213-354-4631
(677-43-16, 677-46-02)

The objective of this study is to understand the applications of and optimum techniques for measuring topography from orbit The study will determine the optimum incidence and convergence angles for both geologic interpretation and the production of topographic maps from radar stereo pairs Specific tasks are to (1) extend the simulation technique to encompass the convergent stereo provided by Shuttle Imaging Radar (SIR-A), (2) develop an analytical theory and error analysis for convergent stereo, (3) continue production of topographic maps from SIR-A image pairs, (4) use simulations and SIR-A results along with orbit design and tracking constraints to determine the best possible stereo experiment for SIR-B In addition the research will assess the utility of combining radar images with those from other visible and infrared sensors for stereo analysis by (1) developing an analytical theory and error analysis for combining images from systems with disparate projection geometries, (2) attempting to produce topographic maps from SEASAT and SIR-A images combined with those from LANDSAT and aircraft photography, and (3) designing verification experiment using SIR-B and the large format camera Finally, the study will determine how well various types of topography can be measured with a raster scanned, pulsed laser altimeter Tasks here include (1) continue laboratory measurements of the backscatter of various target materials to coherent radiation, (2) performing field tests using the laboratory equipment to assess the effects of range depth of natural terrain and varying amounts of natural and man-made background, and (3) completing a conceptual design for an orbital instrument and corresponding aircraft breadboard model

W83-70541 **677-43-18**
Jet Propulsion Laboratory, Pasadena, Calif
SIR-A DATA ANALYSIS
T H Dixon 213-354-4977
(677-46-02, 677-43-16)

The Shuttle Imaging Radar (SIR-A) acquired high quality radar imagery of a variety of geological environments around the earth In order to maximize the scientific return from these data, it is proposed that a number of independant investigations be carried out These studies would concentrate on critical geologic areas and would be conducted by non-NASA researchers familiar with the specific terrains and/or specific data analysis techniques Two broad classes of investigations are planned The first would utilize SIR-A data over relatively well studied sites in the U S and northern Mexico In some cases these sites have two look directions of SIR-A data plus SEASAT coverage These studies

will concentrate on data analysis techniques, and sensor performance analysis A key goal is to quantify the actual information return from SIR-A by comparison with existing ground truth and other remote sensing data This will help define mission requirements for future sensors A second type of investigation will be carried out in areas which are not well known geologically In many remote areas of the earth, the SIR-A data represents the first available radar imagery Investigations utilizing this data are expected to contribute to overall understanding of geologic processes in these regions

W83-70542 **677-45-06**
Goddard Space Flight Center, Greenbelt, Md
CRUSTAL MAGNETIC FIELD REPRESENTATION AND VERIFICATION
R A Langel 301-344-6565

The major objectives of this program are to (1) verify the validity of reduction to pole techniques at the geomagnetic equator and continue optimizaton and development of the equivalent source software, (2) complete and publish the global POGO magnetic anomaly map, (3) identify, characterize, isolate and, if possible, model those external field effects in the MAGSAT data which contaminate the crustal anomaly measurements, and (4) investigate and apply techniques of filtering external fields from anomaly data and of selecting data in which such efforts are minimal and apply these methods to derive a revised MAGSAT anomaly map Smoothing and accuracy criteria for equivalent source solutions will be developed and tested by comparison with data Individual data plots from MAGSAT dawn and dusk, will be compared to each other, to POGO, and to existing external field pedictions The apparent external fields will be identified and characterized and MAGSAT data selected to minimize these effects Fourier and cross-spectral filters will be investigated to see if they improve the elimination of external fields Maps will be generated and published

W83-70543 **677-46-02**
Jet Propulsion Laboratory, Pasadena, Calif
NEW TECHNIQUES FOR QUANTITATIVE ANALYSIS OF SAR IMAGES
D L Evans 213-354-2418
(677-43-16, 677-43-17)

Images from the Shuttle Imaging Radar (SIR-A), flown in November, 1981 were obtained for parts of North America, South America, Australia, Africa, and Asia SIR-A provides a complementary image data set to the SEASAT SAR because data were obtained from areas that were not covered by LANDSAT, and SIR-A images were obtained at a different incidence angle than SEASAT The objectives of this RTOP are to develop and implement new techniques for quantitative analysis of spaceborne multi-incidence angle, airborne multipolarized and multifrequency SAR data The approach will be to acquire multipolarized and multifrequency aircraft SAR data over areas covered by SIR-A and SEASAT in order to determine the effect of polarization, frequency, and incidence angle on image texture and tone, and how these parameters can best be used in mapping geologic units This proposal covers the basic research effort at JPL involving the development and implementation of new techniques for analyzing SAR images for the three year period of FY-83, FY-84, FY-85 It represents the efforts of 4 researchers (3 professionals and 1 post doctoral researcher) who will be addressing techniques for various applications The techniques developed under this RTOP will be used to define experiments needed to better understand and utilize data obtained by SIR-B at variable incidence angles, and future SAMEX missions with multipolarization and multifrequency capabilities

W83-70544 **677-47-03**
Jet Propulsion Laboratory, Pasadena, Calif
AIRBORNE RADAR OPERATIONS
N Herman 213-354-2654
(677-47-07)

The objective is to provide and maintain an operational radar facility for NASA scientific experiments that pertain to the remote sensing of surface characteristics Such experiments are to be conducted by NASA or NASA selected investigators The facility will include the radar sensors and access to data processing facility and provide a full capability to respond to user requests The CV-990 or C-130 aircraft assignments and costs are not being provided for in this RTOP In FY-83, the NASA-JPL L-band SAR will be brought to complete operational readiness and will be used to perform the scientific experiments The system will be placed under configuration control Supporting documentation will be completed for (1) maintenance, (2) operation procedures, (3) system performance and (4) experiment cost estimating will be completed Also in FY-83, the JSC scatterometer will be transferred to JPL where status and performance will be reviewed, the ongoing JSC work will be incorporated, and the L and C band scatterometers will be made operational in FY-84

W83-70545 **677-48-01**
Jet Propulsion Laboratory, Pasadena, Calif
ER SEASAT DIGITAL SAR PROCESSING
T A Andersen 213-354-3964

The objective of this RTOP is to process SEASAT radar data to produce synthetic aperture radar images of land areas in North and Central America in support of Earth resource application investigation studies The processing will be performed using the upgraded interim digital processor in JPL Each image will exhibit a 25 meter resolution and cover a 100 km square target area At least 20 images will be produced in FY-83

W83-70546 **677-48-03**
Jet Propulsion Laboratory, Pasadena, Calif
SPATIAL RADAR IMAGE REGISTRATION
M Naraghi 213-354-6116

The overall objective of this task is to develop SAR image registration methods with increased accuracy and a higher level of automation One of these techniques, which is based on a radar specific distortion model and incorporates digital topographic information in defining the geometric transformation, will be expanded to use all available and pertinent ephemeris data The key effort in this regard will be to fully automate this process so that the present preconditioning of the images, (i e , rotating-scaling and de-skewing), will be a function of the information obtained from the radar system parameters and the few tiepoint locations The procedure will also be fully evaluated by applying it to areas of varied topography while measuring the registration error and developing methods to minimize it A particular procedure which is to be pursued is that of improving the radar parameter estimates by using the information furnished by the tiepoints Currently preprocessing methods are being considered in order to facilitate the difficult task of tiepoint identification One particular method currently under investigation is the development of a procedure to associate the saturated areas of the radar image to corresponding areas of the topographic data whose slopes are close to normal to the radar beam In addition texture, edge detection and various filters will be considered for final pixel to pixel association of the radar image and the topographic data

W83-70547 **677-60-11**
Ames Research Center, Moffett Field, Calif
DIGITAL MAPPING OF IRRIGATED CROPLAND
H W Jones 415-965-6616

The major objective is to develop and test digital LANDSAT techniques to map irrigated croplands within selected aquifers of the western United States The irrigated cropland data required to estimate ground water usage will be generated for the USGS Regional Aquifer System Analysis and Water Use Programs The RTOP will also involve research and test techniques to improve digital mapping of irrigated cropland Crop calendar information will be used to select appropriate dates for mapping irrigated cropland Data will be processed using the most accurate and rapid computer programs, and new programs will be developed to improve results and increase processing effectiveness Multidate data will be overlayed, and all data will be registered to a map base Accuracy will be checked using available ground truth data

W83-70548 **677-60-15**
Ames Research Center, Moffett Field, Calif
REMOTE SENSING APPLICATIONS FOR FACILITY SITE SELECTION AND WASTE DISPOSAL IMPACT ASSESSMENT
D A Mouat 415-965-5896

The overall objective of this RTOP is to develop and test analytical techniques involving the characteristics of the thematic mapper to generate screens (or factors) for facility site selection and waste disposal impact assessment Secondary objectives involve testing the dynamic range, spectral and spatial resolution of the thematic mapper in order to meet the overall objective In order to test these sensor characteristics, new, improved and/or reformatted analytical techniques must be developed and evaluated The multiphase approach involves the selection of test sites situated within diverse ecosystems which are well suited for waste disposal impact assessment and facility siting in coordination with Woodward Clyde consultants The use of airborne scanner data to simulate the TM's sensor characteristics will occur prior to the availability of the thematic mapper data The approach involves several analytical procedures Optimal waveband combination will be accomplished in order to optimize separation of water features, semiarid land cover features, and geologic features Various types of classification procedures will be attempted on the different data sets

W83-70549 **677-60-19**
Ames Research Center, Moffett Field, Calif
USE OF THEMATIC MAPPER DATA FOR ELECTRICAL UTILITY TRANSMISSION CORRIDOR ANALYSIS AND SITING
Ethel Bauer 415-965-5513

The objective of this project is to evaluate thematic mapper and thematic mapper simulator (TMS) digital data as a source for the identification and mapping of features impacting electric transmission line routing The project will attempt to solve various problems previously noted when using LANDSAT MSS data in transmission line routing analysis The approach will be to acquire TMS and ground data sets for agricultural, riparian, and rural urban regions in California Spectral clustering and texture analysis techniques will be developed and assessed for the identification of vineyards, tomatoes, and rice crops which affect transmission line siting Edge/linear detection algorithms will be evaluated as tools for mapping the agriculture infrastructure Contextural classifiers and texture techniques will be examined for effectiveness in riparian vegetation, small water bodies, and rural urban development mapping The above analyses of TMS data will be compared to previous results obtained using LANDSAT MSS in this application

W83-70550 **677-80-22**
Jet Propulsion Laboratory, Pasadena, Calif
IPL UPGRADE. INTERACTIVE DISPLAY/VIRTUAL ROAM
R E Alley 213-354-5693

A set of four or more large (1024 x 1024 samples) refresh memories will be procured and integrated into the existing IPL nonrenewable resources interactive image display processor system Using these newly acquired memories a virtual roam capability will be implemented in software This capability will permit an interactive user to move the viewing window at will around an arbitrarily large scene by high data rate loading of unused portions of the memory in anticipation of user directed motion In addition to supporting image examination, the resulting software can be integrated into other applications programs, such as training and registration

Sounding Rockets

W83-70551 **879-11-38**
Goddard Space Flight Center, Greenbelt, Md
SOUNDING ROCKET EXPERIMENTS
W M Neupert 301-344-5523

The sounding rocket program provides unique capabilities to conduct a broad range of scientific investigations The program is particularly important for the development and demonstration of the merit of new instruments for Shuttle flights and of prototype instruments for satellites Furthermore, the short lead time and program flexibility make it possible to follow up new discoveries and to study particular phenomena on the Sun and in the Earth's atmosphere Extreme ultraviolet spectra of the Sun are a valuable tool for determining the true physical conditions in the solar corona The main objectives are the determination of the flow of matter and energy from one region to another in the corona For this purpose the coronal density, temperature, gas velocity, and radiation field must be known The work under this task is directed toward the development and flight on rockets of instruments for determining these four physical parameters in the corona A better determination of the characteristics of the solar corona is necessary in order to discover the paradoxical reasons why a coronal gas temperature of more than one million degrees can be maintained by energy from a region whose temperature is only five thousand degrees These measurements are also important for determining the origin of the solar wind, which may arise from regions of open magnetic field

W83-70552 **879-11-41**
Goddard Space Flight Center, Greenbelt, Md
SOUNDING ROCKETS EXPERIMENTS (ASTRONOMY)
T P Stecher 301-344-8718

The astronomical sounding rocket program provides a unique capability to conduct a broad range of scientific investigations The program flexibility and short lead time make it possible to observe unusual physical phenomena for which satellite instrumentation is not available The program flexibility makes it possible to expenditiously follow-up discoveries as well as to provide tests and calibrations of satellite instrumentation This unique capability is exploited by obtaining one of a kind observations of those types of astronomical phenomena that do not need large amounts of repetitive data to delinate their physical processes Many new types of observations are now possible because of recent technical advances in both attitude control and new detectors These observations are necessary in order to understand and analyze many properties of the interstellar medium, stars, nebulae, and peculiar galaxies The present objectives are to develop payloads to obtain ultraviolet images of the weak sources now accessible as a result of improved pointing devices Old payloads will be improved and used again and new payloads will be developed to take advantage of modern sensors and image intensifiers The properties of galaxies and *peculiar galaxies will be studied by means of their ultraviolet images* Procedures for absolute photometry of the stars and galaxies will be investigated All instrument development will be done in such a manner that the instruments can be used on Spacelab or as SPARTAN (Shuttle Pointed Autonomous Research Tool for Astronomy)

W83-70553 **879-11-46**
Goddard Space Flight Center, Greenbelt, Md
SOUNDING ROCKET EXPERIMENTS (HIGH ENERGY ASTROPHYSICS)
E A Boldt 301-344-5853

High energy astrophysics (especially X-ray astronomy) is a rapidly evolving field of research, both scientifically and technically The exploitation of the capabilities of short lead time, planning flexibility, accurate pointing and extremely high telemetry rates (most important) afforded by rocketborne experiments are major factors in the success to date, a vigorous elaboration of this activity is now necessary for continuing to make timely and important contributions that complement data from satellite missions and for the effective planning of advanced future missions (e g , BBXRT, AXAF) This involves experiments with systems incorporating newly developed spectrometers and X-ray concentrators

OFFICE OF SPACE TRACKING AND DATA SYSTEMS

Advanced Systems

W83-70554 **310-10-23**
Goddard Space Flight Center, Greenbelt, Md
SOFTWARE TECHNOLOGY
Frank E McGarry 301-344-5048

The objective of this RTOP is to identify, evaluate, and refine software engineering technology as applied to three disciplines of software development, management, and maintenance The software engineering technology to be studied includes software methodologies (such as design techniques, structured implementation techniques, and design evaluation techniques), software tools (such as management support tools, code auditors and analyzers, and automated design tools), and software support models (such as resource estimation models or reliability estimation models) The identified methodologies are intended to significantly reduce the overall life cycle costs of the software within the mission and data operations area The approach to attain the stated objectives includes the establishment of a laboratory environment through which the identified areas of software technology can be investigated, measured, and refined under suitable conditions The laboratory will support the research effort in the area of software development, management, and maintenance Within the laboratory environment, candidate technologies will be identified, appropriate measures to be used in the evaluation process will be developed, a data collection scheme will be identified, and the experiments will be conducted where the candidate methodologies will be applied to software development and maintenance tasks This is a systems level RTOP supporting the areas of Tracking and Data Relay Satellite System operations, mission support computing, and mission operations

W83-70555 ***310-10-26***
Goddard Space Flight Center, Greenbelt, Md
ATTITUDE/ORBIT TECHNOLOGY
Arthur J Fuchs 301-344-6846
(506-61-06, 312-80-53, 310-40-46)

Develop, evaluate, and demonstrate new technology for attitude and orbit determination/prediction/analysis for both ground based and onboard application, including algorithms, techniques, software, and hardware The technology developed under this RTOP supports the Space Tracking and Data System in the areas of mission computing and analysis, Tracking and Data Relay Satellite System operations, and data processing Various techniques, algorithms, and filters will be developed and evaluated for their applicability to automated and improved orbit and attitude determinations and control configurations The configuration may be onboard or ground based Another task will analyze various ground control point (GCP) processing algorithms, and design automated techniques for GCP registration Finally, onboard as well as ground based applications of microprocessor based orbit and attitude determination systems will be investigated

W83-70556 **310-10-42**
Goddard Space Flight Center, Greenbelt, Md
PRECISION TIME AND FREQUENCY SOURCES
S Clark Wardrip 301-344-6587
(644-03-05, 676-59-35)

The objectives of the RTOP are to develop improved frequency and time standards, to improve existing hydrogen maser frequency standards, and to develop associated time and frequency distribution and measurement systems for very long baseline interferometry and near Earth and deep space tracking The NR masers will continue to be upgraded Major improvements planned are the evaluation of a quartz cavity liner and the construction of an integral quartz cavity design for the NR type maser Testing and evaluation of the external bulb maser will proceed as soon as operation is achieved in this unit Long term testing and operation of masers will be undertaken to develop the doctrine of operation necessary for long term stability performance Automated measurement systems will be established under controlled environmental conditions to support these tests

W83-70557 **310-10-60**
Jet Propulsion Laboratory, Pasadena, Calif
RADIO METRIC TECHNOLOGY DEVELOPMENT
P S Callahan 213-354-4753
(310-10-62, 310-10-63, 310-10-64)

The broad objective of this RTOP is development of advanced radio metric systems used by the Deep Space Network (DSN) for spacecraft navigation and radio science The navigation requirements which will be placed upon the DSN by future missions are expected to be stringent (50 nrad) The techniques having the greatest potential for improved navigation accuracy utilize very long baseline interferometry (VLBI) The main development effort is focused on differential VLBI measurement schemes, referred to as delta VLBI This method involves differencing measurements from a spacecraft and an angularly nearby extragalactic radio source (EGRS) Common mode errors in the measurements cancel to give precise EGRS relative position or position rate information Near term goals are to (1) demonstrate a 50 nanoradian delta VLBI capability and (2) provide the technology development required for EGRS relative spacecraft navigation, such as identification of radio sources useful for navigation, demonstration of ways to establish the planetary ephemerides in the EGRS reference frame, and development of media calibration techniques In addition to improved accuracy, reduced cost of navigation is an important consideration Obtaining all six components of the spacecraft's position and velocity with the VLBI system to reduce both tracking and processing costs will be investigated The development of special purpose systems of tracking high earth orbiters with increased accuracy and/or reduced costs will also be investigated The VLBI data are used to support navigation thru the determination of earth platform parameters and EGRS positions The long term goal is to develop a VLBI system capable of 5 nrad (23 cm) accuracy Near term objectives include (1) demonstrate 1 cm delay measurements (instrumental precision) on a short baseline (2) demonstrate 2 cm tropospheric calibrations Other work under this RTOP provides extensions of VLBI correlator technology to support nonreal time arraying and antenna panel alignment A VLSI correlator will be developed

W83-70558 **310-10-62**
Jet Propulsion Laboratory, Pasadena, Calif
FREQUENCY AND TIMING RESEARCH
R L Sydnor 213-354-2763
(310-10-60 310-10-61, 310-10-64, 310-10-68)

The thrust of this RTOP is the development of frequency and time standards, distribution systems and utilization equipment for use in the Deep Space Network (DSN) during the next decade Accurate frequency and time are the basis for outer space navigation, for very long baseline interferometry based experiments, and for geodesy The reliability and maintainability must be improved in order to decrease M and O costs and increase H maser availability to 99 9% The goal is to improve the mean time between failures from 25 months to 5 years and the mean time to repair from 3 months to 3 weeks In addition, the present frequency and timing performance of the DSN of 10 to the -14th power and 100 nsec must be improved by the mid-1980's to 3x10 to the -16th power and 10 nsec The goal for the late 1980's and early 1990's is 10 to the -17th power and 1 nsec New technology, such as trapped ion, superconducting cavities or cryogenic quartz oscillators, must be developed to achieve these goals Redundant frequency standards are planned to achieve the high system reliability, so that means must be provided in the form of a Frequency Standard Selection and Control System (FSSCS) to achieve switching to alternate standards upon failure of the prime standard with minimum change of phase or frequency The goal is 10 to the -2nd power degrees of phase and 10 to the -15th power change in frequency Effective utilization of the high stabilities achieved by the frequency standards requires precision frequency and time distribution Fiber optic and satellite distribution systems will be developed to disseminate these reference signals at distances from 10 meters to 20,000 km The goal of the fiber optic system for 10 meters to 20 kilometers is 10 to the -18th power frequency stability and 0 1 nsec time stability The goal for satellite time synchronization between the DSSs is 1 nsec The capabilities of the end-to-end DSS to support these stabilities will be evaluated with a near term goal of meeting the 3x10 to the -15th power stability needed for X-band uplink

W83-70559 **310-10-63**
Jet Propulsion Laboratory, Pasadena, Calif
SPACE SYSTEMS AND NAVIGATION TECHNOLOGY
J Ellis 213-354-2788
(310-10-63)

The basic objective of this RTOP is to establish the anticipated navigation requirements for Deep Space Network (DSN) supported deep space and high earth orbiter (HEO) missions planned for the 1985-2000 era and to assess their implications on the DSN radio metric system Drivers for future development are the stringent navigation accuracies anticipated for outer planet and for planetary orbiter missions and the need for navigation concepts to enable support of low cost missions planned for the Mariner Mark 2 and Pioneer set The RTOP identifies and evaluates radio metric data strategies and advanced navigation concepts capable of achieving these goals A related activity is the development of prototype navigation data processing concepts to reduce mission operations costs and increase efficiency and reliability Current goals of the navigation technology work units are to (1) establish radio metric data requirements for new navigation functions such as asteroid and comet orbiters, (2) develop orbit determination strategies to minimize navigation performance sensitivity to critical error sources such as instrument calibration errors and quasar position uncertainty, and (3) formulate and evaluate navigation concepts to enable support of low cost missions and expand the usage of DSN capabilities The latter includes strategies which exploit delta very long baseline interferometry capabilities for deep space, HEO and TDRS navigation, application of space telescope observables to complement DSN radio metrics, and dual spacecraft tracking techniques A complementary goal is to implement and demonstrate a prototype multimission navigation data processing facility on a dedicated VAX 11/780 The prototype system will serve as a foundation for the long range goals which are to develop high speed computer graphics capabilities, and initiate automated event driven operations and diagnostic procedures

W83-70560 **310-20-33**
Goddard Space Flight Center, Greenbelt, Md
NETWORK SYSTEMS TECHNOLOGY DEVELOPMENT
J Schwartz 301-344-7313

The objective of this RTOP is to investigate the applicability of new technology in the Tracking and Data Relay Satellite System (TDRSS) era Selected technology will be investigated by means of feasibility studies, prototype development and demonstration, and by cost and reliability impact studies A major goal is to investigate the effect of nonGuassian channel characteristics on TDRSS link performance and develop coding and signal designs which optimize link performance Associated with this goal is the objective of validating the analytical predictions by means of limited hardware simulations

W83-70561 **310-20-38**
Goddard Space Flight Center, Greenbelt, Md
SATELLITE COMMUNICATION TECHNOLOGY
D D Wilson 301-344-5257

The objective of this RTOP is to introduce efficient high-rate digital telecommunications transport systems to support NASA programs by 1986 The work focuses on two major tasks whose objectives are to define and demonstrate an efficient multinode satellite-based digital telecommunications systems which can provide to geographically dispersed users multiple access on a common line, and to define and demonstrate advanced signal processing and coding techniques which could provide an improvement in data transmission speed and performance through 36 MHz C-band domestic satellite transponders The approach for each task is as follows (1) define the system requirements and resultant network architecture, and then, develop and demonstrate the system elements including low cost implementation of time division multiple access (TDMA) terminals, maintenance and control terminals, digital voice Codec, forward error correction Codec, and transportable TDMA Earth stations (2) evaluate the feasibility of combining the best performance of signal processing and coding elements to provide 85 MB/S transmission through a C-band transponder at 1x10(-7) bit error rate and 99 5% error free seconds with specified satellite system characteristics

W83-70562 **310-20-39**
Goddard Space Flight Center, Greenbelt, Md
VERY LONG BASELINE INTERFEROMETRY (VLBI) TRACKING OF THE TRACKING AND DATA RELAY SATELLITE (TDRS)
Philip E Liebrecht 301-344-7782

The objectives of this RTOP are to utilize very long baseline interferometry (VLBI) tracking of the Tracking and Data Relay Satellites (TDRS) as an independent measure with which to validate the TDRSS tracking capability, to demonstrate the application of passive VLBI techniques to improve TDRS trajectory determination, and determine the detailed requirements and specifications for an operational, dedicated, TDRS VLBI system A three phase approach will be used During the first phase, an experiment will be conducted to demonstrate the feasibility of the technique and provide data for comparison with the bilateration ranging transponder (BRTS) derived orbits The second phase will involve formulating overall functional requirements and system analysis for a dedicated operational system leading toward the final phase which will develop complete detail system specifications for such a system

W83-70563 **310-20-46**
Goddard Space Flight Center, Greenbelt, Md
ADVANCED SPACE SYSTEMS FOR USERS OF NASA NETWORKS
R P Hockensmith 301-344-9067
(506-61-26)

The objective of the work under this RTOP is to achieve technological advances in radio frequency (RF) systems, antenna systems and associated control technology, on board data storage systems, and in telecommunications coding These developments will satisfy future requirements of user's of NASA networks (spacecraft and space transportation system payloads) that require near global coverage through communications relay satellite systems (Tracking and Data Relay Satellite System, Tracking and Data Acquisition System) for the support of the missions The approaches for accomplishing the objective are to (1) identify the basic operational communication requirements, (2) investigate RF active and passive components and antenna systems that are feasible, but may be a technical risk, to attain the required RF performance, (3) investigate methods of reducing and controlling torque noise induced into space platforms due to electromechanical steering of large high gain antennas, (4) investigate methods of high density and high rate recording and storage (5) investigate improvements in telecommunication coding schemes for spacecraft generated data, (6) develop system designs incorporating these optimum subsystems to permit user projects to specify proven, reliable hardware with a high confidence level in the performance capability, cost, and required procurement cycle, (7) exploit necessary improvements in testing techniques that properly characterize these critical systems

W83-70564 **310-20-64**
Jet Propulsion Laboratory, Pasadena, Calif
X-BAND UPLINK DEVELOPMENT
Rob Hartop 213-354-3433
(310-20-65, 310-30-68, 310-30-70)

The objective of this RTOP is the development of a phase-stable multi-kilowatt automated wideband uplink capability at X-band for future Deep Space Network (DSN) missions This objective is being met by the development of 20 KW transmitter system and receiver/exciter operating at 7 2 GHz with a prototype multifrequency feedcone at DSS-13, and by the operation of two 400 KW transmitter subsystems at DSS-14 as planetary radar instruments Among them, these three transmitters will demonstrate the capability for reliable superpower transmitters with 1000 second frequency stabilities of 5 parts in 10 to the 15th power and fully automated operation X-band uplink provides an alternative for the congested S-band uplink frequency band and provides more reliable command and telemetry performance while in two-way lock near solar conjunction The wider bandwidth ranging possible with X-band uplink promises more precise navigation of spacecraft and improved radio science The high phase stability also enhances navigation and increases the probability of gravity wave detection Full automation of the 20 KW transmitter will enable substantial reductions in network operational costs through reduced operator intervention Moreover, this effort will demonstrate the technology required for automation of the superpower transmitters, thereby providing increased productivity and availability Specific FY-83 objectives includes (1) completion of the receiver/exciter with automation (2) evaluation of the complete X-band system at DSS-13 for phase stability and other key telecommunications parameters, (3) continued evaluation of the new microwave feedcone assembly, (4) preliminary research into the feasibility of simultaneous dual-frequency two-way uplinks, and (5) continued support for superpower planetary radar by maintenance and operation of the DSS-14 R and D transmitters Long term objectives include the development of a reliable dual-frequency (nomially S-and X-bands) capability, development of highly reliable automated superpower transmitters, research into superpower waveguide techniques at X-band and higher frequencies, and research into 32 GHz transmitter technology

W83-70565 **310-20-65**
Jet Propulsion Laboratory, Pasadena, Calif
ANTENNA SYSTEMS DEVELOPMENT
D A Bathker 213-354-3436

The objective of this RTOP is to identify, develop, and utilize selected applicable technology related to large earth station antennas for deep space communications, radio and radar science for the 1985 to 1995 time frame The technology development effort aims at enabling the optimum use of existing facilities through affordable modifications and the construction of new facilities with maximized performance and minimized capital outlay and life cycle cost The approach includes (1) software intensive analytic scattering studies for RF performance prediction (2) trial reflector designs, carried through to concept development and demonstration, (3) field demonstration of advanced multiband feeds, (4) software intensive analytical multiple constraint structural optimization for efficient designs of large, precise, electromechanical antenna structures and servo mechanisms, and (5) investigation of techniques and processes to enable affordable fabrication and use of precise reflector surfaces Current work will complete the performance determination of a modeled clear aperture reflector and begin study of beam-waveguide-feed subreflectors to accomplish shaped-reflector performance in affordable ways Work on 64m antenna upgrades has the goal of a 1 9 dB X-band gain increase Modifications to be studied include (1) shaped reflector surfaces with optimum design for the complex tricone feed arrangement (2) Y-axis subreflector focusing, (3) reflector panels with improved surface precision, (4) additional structure bracing, and (5) extension of main reflector diameter to 70m Additional work concentrates on precision radio-astronomical measurements at X-band and K-band to better characterize the 64m antenna performance and on the development of microwave feed systems with increased versatility

W83-70566 **310-20-66**
Jet Propulsion Laboratory, Pasadena, Calif
RADIO SYSTEMS DEVELOPMENT
Dean L Johnson 213-354-4942
(310-20-66)

The objective of this RTOP is to improve the earth-based receiving elements of the spacecraft-to-earth communications link in order to meet the future navigation, telemetry, and science needs of the space exploration program This will require greater receiving capabilities such as wide instantaneous bandwidths, broad frequency tuning range coverage, total system frequency stabilities better than 1 part in 10 to the 15th power, and high reliability to reduce maintenance and operation costs and permit unattended operations The RTOP objective will be met by (1) the development of a multifrequency, ultra-low noise amplifier system to cover S, X, and Ka-bands with 500 MHz instantaneous bandwidths, this multifrequency amplifier system will consist of S- and X-band parametric upconverters and a Ka-band maser in a single 3 Watt closed cycle refrigerator (CCR), (2) the establishment of a parametric upconverter development capability to assure the availability of ultra-low noise, wide bandwidth, cryogenically cooled parametric upconverters at any frequency between 1 and 30 GHz, with emphasis on existing bands at 2 3 and 8 4 GHz, (3) the development of cyrogenic filters to provide low noise amplifier protection from in-band and out-of-band radio frequency interference, (4) the development of technology to improve the reliability and increase the efficiency of the cryogenic cooling equipment (the goal will be to achieve an MTBF of one year for the reliability and an efficiency of five percent of Carnot efficiency, more than a factor of two improvement over the present DSN 1 watt CCR), (5) development of a receiver system design with the versatility, stability, and unattended operation compatibility needed for the future DSn at a minimum life cycle cost and (6) calibration and modeling of the propagation medium and the establishment of a data base of the statistics of meteorological effects at X- and Ka-band

W83-70567 **310-20-67**
Jet Propulsion Laboratory, Pasadena, Calif
COMMUNICATIONS SYSTEMS TECHNOLOGY DEVELOPMENT
J R Lesh 213-354-2766

The objective of this RTOP is to develop communication systems technology required to meet the needs of the Deep Space Network (DSN) supported missions for the late 1980's and 1990's During this time frame communications links which make more efficient use of power and which have substantially reduced size, weight and cost will be required for planetary exploration Additionally, the easy access to space afforded by the space shuttle will result in increased Earth orbit

activities These in turn will produce the need for spaceborne relay of signals and eventually spaceborne operational control To meet the foreseen needs for NASA space communications the RTOP has been structured along two major thrusts The first focuses on improving or expanding the capabilities of current microwave communication techniques and includes work units for extending by at least 1 5 dB the threshold of the current DSN telemetry system, for developing coding and modulation techniques which are consistent with the present day constraints on complexity and which have the potential of an additional 2 0 dB reduction in required signal to noise ratio, and for realizing complex channel decoding structures in VLSI technology The second major thrust involves the use of optical frequencies for communication and contains work units for the conceptual design and demonstration of optical communications techniques (including the demonstration of 2 5 bit/detected photon data transfer during the beginning of FY-83), for the design and comparison of optical communications systems, and for the evaluation of the impacts of optical communications technology on spacecraft mission types which the DSN supports

W83-70568 **310-20-68**
Jet Propulsion Laboratory, Pasadena, Calif
STATION MONITOR AND CONTROL TECHNOLOGY
Conrad Foster 213-354-5070
(310-20-64)

The objectives of this RTOP are the development and demonstration of technology for unattended tracking station operations, and the generation of a data base for assessment of the impact of unattended operations on network productivity and network life cycle costs The approach used is the development of a test bed remote controlled unattended station at DSS 13 This test bed includes automated control of an unattended 26-M antenna, high power transmitter, receiver-exciter, and data processing subsystems (subcarrier demodulator) Control of the equipment is from JPL This test bed has evolved over several years to include an increasingly comprehensive set of subsystems, and improved operator interfaces Fully unattended receive capability was demonstrated for six months in FYs 78 and 79 to provide controlled life cycle cost data Unattended operation of the high power transmitter was demonstrated for two months in FY-80 to 81 Emphasis in FY-83 will be (1) to implement operator interface improvement to reduce human errors (2) test monitor and control functions of microprocessor-based antenna controller, (3) add control and monitor of prototype noise adding radiometer, (4) install and test automated traveling wave maser amplifier and closed cycle refrigerator, (5) collect data on reliability of commercial computational modules used in automation effort, (6) demonstrate concept of Spacecraft Surveillance System using DSS-13 antenna and RFI trailer Additionally, automation of preventive maintenance diagnostics of critical elements such as traveling wave masers is underway as is the improvement of automatic receiver acquisition at or near threshold

W83-70569 **310-30-69**
Jet Propulsion Laboratory, Pasadena, Calif
NETWORK MONITOR AND CONTROL TECHNOLOGY
K I Moyd 213-354-4608

The Network Operations Control Center (NOCC) provides the centralized real-time control of the Deep Space Network (DSN) and monitors and validates DSN performance The present implementation of the NOCC real-time system is labor intensive in its operations difficult to modify, runs at or near full capacity of its resources and is without the flexibility for further growth The existing NOCC real-time system was designed and developed around methodologies and hardware which were available and proven in the early 1970's The broad objective of this RTOP is to develop and demonstrate a new functional architecture for the network real-time monitor system which will make use of the technological and methodological advances which have taken place since the inception of the existing NOCC system Specifically, a replacement architecture will be developed which will include (1) consideration of expected system functional requirements for the 1990's, (2) allowances for projected growth in commercially available hardware, (3) consideration of hardware-software tradeoffs, (4) modularity in design to accommodate future expansion or modification, and (5) operational efficiency with the goal of minimizing human intervention The architectural design will lead to selected demonstrations of key concepts during FY-83 through 85 This development will focus on a functional architecture, rather than a hardware architecture, and will use high-level standardized technology, thus allowing the replacement NOCC to take advantage of subsequent hardware improvements without requiring redesign or significant changes to software and remaining hardware

W83-70570 **310-30-70**
Jet Propulsion Laboratory, Pasadena, Calif
HIGH-SPEED SIGNAL PROCESSING RESEARCH
George S Downs 213-354-2765

The purpose of this RTOP is to investigate, develop test, and demonstrate advanced signal processing techniques and equipment which enable the Deep Space Network (DSN) to plan and achieve its performance requirements at reduced risk and cost to implementation and operations The engineering objectives are (1) to design, develop, build, and operate a high-speed signal processing test-bed at Goldstone incorporating large scale integrated (LSI) circuits where possible (2) utilize this test-bed for real-time acquisition and processing for several classes of users (rapid automated reconfiguration of the test-bed elements will permit one processor system to serve all user classes), including high-rate telemetry validation antenna arraying for distant spacecraft, weak signal decoding, radio frequency interference (RFI) characterization and avoidance, and planetary radar (radar observations of Venus are to be used for the initial processing demonstration where a 2 MHz sampling rate in 6 parallel channels is reduced to a data flow of 150 kBytes/sec onto magnetic tape) and (3) characterize the RFI environment at Goldstone, providing data to the NCP effort During FY-83 the tasks are complete construction of the A/D converters and the correlators and integrate with the newly acquired VAX 11/780 computer, certify the operation of the test-bed, and move to Goldstone for evaluation and use design and start constructing additional signal processing blocks (FFT, array processor) pursue the design and fabrication of LSI circuits in high-speed Ga-As via a 1 GHz correlator circuit, and begin work on a Ga-AS A/D converter, complete the S-Band RFI report, add detection algorithm hardware to the RFI system, and obtain processed echoes from planetary surfaces with the high power radar system

W83-70571 **310-40-26**
Goddard Space Flight Center Greenbelt, Md
OPERATIONS SUPPORT COMPUTING TECHNOLOGY
D T Ketterer 301-344-8460
(310-10-49, 310-10-23 310-40-37 310-10-26)

This is a subsystem level RTOP which is aimed at improving the accuracy timeliness, cost effectiveness, and management of operational ground-based orbit computations in the Tracking and Data Relay Satellite System era It addresses the evolution of operations support computing (OSC) technology into the later 1980's and beyond This objective is accomplished through system studies to determine, develop, and analyze advanced operational concepts, a management information system, and computer system designs, and through concept test and evaluation via prototype implementation of specific capabilities in controlled environments System studies in FY-83 will concentrate on developing concepts and techniques for a computer based information system to improve OSC management functions Other tasks will focus on the demonstration of human engineering and advanced operational concepts in the mission support computing environment A Research and Technology Support Facility (RTSF) employing intelligent terminals will be implemented and dumb terminals will be enhanced to develop and demonstrate recommended concepts

W83-70572 **310-40-37**
Goddard Space Flight Center, Greenbelt Md
HUMAN-TO-MACHINE INTERFACE TECHNOLOGY
W F Truszkowski 301-344-9261

The objectives of this RTOP are to develop and apply natural man/machine interfaces for space payload and ground control systems, and develop a methodology and guidelines which emphasize the human factors issues associated with man/machine interfaces The intention is to apply recent advances in human factors analysis, low-cost microprocessor hardware, and artificial intelligence software techniques augmented with audio and touchtone input/output technology to the man/machine interface problems associated with such systems The approach to be taken is first, to identify and apply state-of-the-art voice/touchtone technology to mission and data operations systems interfaces, second, to apply human factors and advanced knowledge representation techniques and methodologies in the development and application of user interfaces to various data/information bases actively used in the mission and data operations environment, and thirdly, to formulate a plan and investigate the feasibility of establishing a human factors lab environment to support near-term application-directed man/machine interface development and testing This RTOP is a system-level RTOP supporting Tracking and Data Relay Satellite System operations, mission operations, and mission support computing

W83-70573 **310-40-45**
Goddard Space Flight Center, Greenbelt Md
MISSION OPERATIONS TECHNOLOGY
R G Sanford 301-344-6138

The mission operations technology RTOP is a subsystem level RTOP, the objective of which is to transfer state-of-the-art hardware, software, and automation technology to the mission operations environment to improve operations efficiency and reliability and reduce costs This RTOP is divided into two tasks control center automation and distributed control research The control center automation task seeks to develop a highly automated operations control center capable of supporting multiple simultaneous missions by the study and specification of the levels of automation for systems resource allocations, connection, test, and status reporting The distribution control research task will provide the technology required for a workable distributed mission control environment by the development and implementation of a distributed command management software systems

W83-70574 **310-40-46**
Goddard Space Flight Center, Greenbelt, Md
IMAGE PROCESSING TECHNOLOGY
Frederick W McCaleb 301-344-6386

This RTOP supports the development and utilization of image processing technology Currently there are two major objectives of this RTOP (1) utilization of optical disk data storage technology in image processing systems, and (2) development of automatic quality control (QC) capability for image processing systems These objectives are being pursued as two independent tasks Task one pursues the development of the systems technology required to utilize optical disk recorder/reproducers for image data storage in image processing systems Task two assesses available QC techniques to determine if they can be automated and identifies processing functions which cannot be automatically quality controlled

W83-70575 **310-40-49**
Goddard Space Flight Center, Greenbelt Md
SYSTEMS MANAGEMENT TECHNOLOGY
Paul J Ondrus 301-344-8001

The objective of this RTOP is to develop and validate concepts and techniques which can optimize the evolution and operation of space tracking and data systems (STDS) Its major objectives are (1) the automation of the requirements definition process, (2) the definition, design, and implementation of a cost allocation/prediction model for STDS subsystems, and (3) the formulation of a research program to explore the nature of control and decision making in large-scale decentralized systems The RTOP approach is to develop associated tools and techniques, apply the techniques to representative STDS problems, and evaluate both the techniques and the results prior to its operational introduction in STDS The analysis of these specific issues and the development of the specified system management techniques are needed in order to provide an information base and tools that can be used to improve the productivity and effectiveness of STDS systems during the 1980's This RTOP is a system level activity supporting spacecraft data acquisition, TDRSS operations, data processing, mission operations, and mission support computing

W83-70576 **310-40-72**
Jet Propulsion Laboratory, Pasadena, Calif
NETWORK SOFTWARE DESIGN TECHNOLOGY
William M Whitney 213-354-4410

The focus of this RTOP is on software methodology and tools that will reduce cost and increase human productivity in the design and implementation of Deep Space Network (DSN) hardware and software Two broad objectives are being pursued The first is to develop a coherent approach to software-system engineering for DSN systems, and to create a family of tools that will put this methodology to use and at the same time test its validity One tool (SOFTCOST) makes it possible to forecast overall resource requirements in software implementation Another (CRISP) supports software design and analysis During FY-83, these tools will be augmented and improved, and installed on the Management and Development Network (MADNET) to demonstrate their feasibility A new tool is being developed to promote structured design and good documentation with minimum effort on the part of people writing programs in support of DSN research and development The second broad objective is to provide software facilities for computer aided design of large scale and very large scale integrated circuits (LSI/VLSI) A coherent, well-integrated set of computer tools will be developed to assist DSN engineers in the design and design-verification of custom LSI/VLSI circuits As a first step, tools developed elsewhere will be imported for use by DSN designers, eventually these will be improved, adapted to reflect DSN technologies and design practices, and brought together under an executive program A more powerful system of software facilities is also to be provided that will enable system engineers to design chips for certain classes of digital functions without having to elaborate and manage the details of circuit layout at the geometrical level What these classes should be will be ascertained in a study of future DSN applications and their requirements

OFFICE OF SPACE TRANSPORTATION SYSTEMS

Advanced Programs

W83-70577 **906-50-00**
Marshall Space Flight Center, Huntsville, Ala
SPACE PLATFORM SPECIFICATION DEVELOPMENT
L E Powell 205-453-5310

The objective of this effort is to develop the system and subsystem specifications required for a free-flying space platform to support science and applications requirements as an element of a space station concept of a cluster of space platforms tended by a manned space station The results of the space station mission analysis studies will be used in conjunction with the experience gained from the space platform payload accommodations analysis to determine the accommodations to be provided to the payloads of the free-flying platforms A contractor participating in the space station mission analysis contract reviews will assimilate the science and applications data to determine the accommodations required by the science and applications users and convert this into a document of system and subsystem requirements/specs These requirements will be utilized by the Phase B and Phase C/D Space Station contractors to determine the method of spinoff, evolution and etc of systems or subsystems from the Space Station for the elements of the free-flying platforms

W83-70578 **906-54-00**
Lyndon B Johnson Space Center, Houston, Tex
MANNED FACILITIES
R F Baillie 713-483-2703

The shuttle provides this country with a new level of capability in transportating payloads to low Earth orbit (LEO) both from cost and on-orbit operations standpoints, and it will effectively double the single-launch mass capability to geosynchronous orbit (GEO) The shuttle system also has the capability for servicing satellites in LEO and for assembling systems which have an operational configuration somewhat larger than the orbiter payload bay Commercial and defense requirements have been established which necessitate extending large payload capability and manned operations out to GEO and beyond The most effective way to do this is by establishing an operations center in LEO which, in effect, is a staging area (or forward base) for ground-to-GEO transportation system, a station which supports the assembly, launch, recovery, and servicing of large unmanned payloads and manned modules for missions to GEO and back to LEO This space station would also provide the additional capabilities of constructing complex space systems too large for a single shuttle launch and of providing periodic servicing for co-orbiting commercial, science, and applications satellites The approach in FY-83 will be to continue in-house and funded generic system studies and proto-type hardware development and to initiate activities concerning SS operations and mission planning

W83-70579 **906-54-20**
Langley Research Center, Hampton, Va
SYSTEM ANALYSIS AND EVALUATION OF PERMANENTLY MANNED ORBITING SPACE FACILITIES
W R Hook 804-827-3666

System analysis and evaluation of competing system design concepts and missions relative to achieving permanently manned orbiting facilities in space is to be performed A stable and well-controlled approach to system analysis will be employed, which uses proven computer-aided design and analysis techniques and methodologies to perform technical and programmatical evaluation tasks to obtain system trade-off and design sensitivity data System design synthesization, analytical modeling, and system analysis tasks will be performed, and an accessible multidisciplinary subsystem technical data base will be developed for the purpose of establishing design, cost, and mission model benchmark as needed for comparative evaluation between manned facility approaches which are evolving within both the U S National and European aerospace communities Parametric analyses will be performed to determine the relative merits of each concept and the technology needs which are conept peculiar and which are more basic

W83-70580 **906-55-00**
Marshall Space Flight Center, Huntsville, Ala
STRUCTURAL ASSEMBLY DEMONSTRATION EXPERIMENT (SADE)
J K Harrison 205-453-2817

The SADE objectives are (1) to demonstrate that the shuttle is a suitable base for space construction, (2) to determine the extent to which neutral bouyancy simulator test results can predict flight test results, and (3) to validate and demonstrate the SADE truss design by measuring the performance of the deployment and assembly operation A single flight in 1985 is planned to construct a 50-foot long truss structure using both deployment and assembly techniques The construction operation will require EVA and RMS activity The entire construction procedure will be simulated in the MSFC neutral buoyancy simulator before the flight Hardware already developed will be modified for use in these simulations Flight hardware configurations will be based on the results from these simulations

W83-70581 **906-58-00**
Marshall Space Flight Center, Huntsville, Ala
MANNED FACILITIES (SPACE STATION)
W G Huber 205-453-0413

The objectives of this effort are to provide supporting studies and advanced development in support of the space station program The approach is to perform contracted and in-house analyses of key space station issues, subsystems, and mission implementation scenarios focused on technical background to support Phase B and subsequent development as well as provide for the test and demonstration of critical space station subsystems and new technologies necessary for a commitment to flight hardware development in 1985-1986 The FY-83 effort will include continuation of the space station mission implementation studies, analyses of key space station system issues, and continued testing of critical subsystems with breadboard hardware

W83-70582 **906-63-00**
Marshall Space Flight Center, Huntsville, Ala
HIGH ENERGY UPPER STAGE
R E Austin 205-453-2796
(506-63-29)

The objective of this effort is the preliminary definition of the high energy upper stage (HEUS) system and development of planning and cost data to support subsequent hardware design and fabrication contract as well as the conducting of critical subsystems supporting development activities In-house and contract studies have developed requirements and candidate concepts for a HEUS system The management of the definition studies and participation in all aspects of these studies through participation in study reviews, review of contractor documentation, correlation of related advanced development activities and interfacing elements (DOD, STS, TDRSS, launch facilities, etc) activities will be used as the basis for the Phase C/D effort It will also provide the cost and schedule data required

W83-70583 **906-63-00**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED TRANSPORTATION
R F Baillie 713-483-2703

Proposed space missions for the 1980's will require the addition of STS orbit-to-orbit transportation stages which augment the current capability of the IUS and provide for the presence of man's unique capability in geosynchronous orbit The objectives of this RTOP are to investigate techniques for operating advanced orbital transfer vehicle (OTV) from a space station and to determine feasibility of utilizing aero-assisted bracking techniques Funded RTOP's will investigate GN&C requirements and propellant transfer requirements In-house activities will be initiated on aerodynamic-assisted OTV's Specific Tasks for FY-83 include OTV GN&C requirements analysis, cryogenic propellant requirements analysis, and flight demonstration of gas dynamic technologies for aerodynamic/assisted OTV's

W83-70584 **906-64-20**
John F Kennedy Space Center, Cocoa Beach, Fla
SPACE OPERATIONS STUDY, FOLLOW ON
F C Bryan 305-867-4010

The first phase of the KSC Space Operations Study was initiated in 1982 to analyze space station-oriented operations and activities from a ground operations perspective This study applied ground operations expertise in assessing various space operations to define operational requirements, develop approaches and scenarios, and identify possible innovations and candidate items for further technology development The second phase of this study will further explore selected space operations to refine the operational requirements evaluate alternative approaches and substantiate the needs for identified technology developments Detailed analyses of significant space methods, resources, issues and concerns will be conducted to ensure effective and timely support to the space station development process The study will also pursue in depth the proper operational tradeoffs between space station operations and ground operations in order to minimize new requirements placed upon deployable spacecraft that are processed through the space station

W83-70585 **906-64-21**
John F Kennedy Space Center, Cocoa Beach, Fla
ADVANCED SPACE TRANSPORTATION SYSTEMS GROUND OPERATIONS
H J DeLaRosa 305-867-2163

In support of work being done by MSFC on the shuttle derived class of vehicles, a one year study was initiated by KSC to look at the launch site requirements to process these kinds of vehicles The study defined in concept terms any new facilities, modifications to existing facilities, impacts to on-going STS activities, ground support equipment, ground operation activities as well as estimated manpower and cost associated with the processing and launch of each of the vehicles covered by this study The level of detail of the defined requirements was sufficient to determine the basic impact to the launch site facilities schedules, and manpower with corresponding cost estimates but was not to a level sufficient to implement the program at the launch site This study effort will build on the data previously developed to a level consistent with the MSFC study activity eliminating configurations no longer being considered by MSFC and adding or highlighting configurations consistant with the MSFC studies

W83-70586 **906-64-22**
John F Kennedy Space Center, Cocoa Beach, Fla
SPACE STATION GROUND OPERATIONS STUDY, FOLLOW ON STUDY
F C Bryan 305-867-4010

The JSC Space Operations Center and the MSFC manned platform will be of modular construction, consisting of habitation, service, and logistics modules The initial study assessed the operational planning for processing the space station elements through the KSC and assessed ground operations vs space operations from a payload point of view This follow on study will provide further definition of the ground operations approaches, processing plans, and resource requirements Interface verification will be addressed in further detail

W83-70587 **906-64-23**
John F Kennedy Space Center, Cocoa Beach, Fla
GROUND OPERATIONS ASSOCIATED WITH SPECIAL FLIGHT DEMONSTRATIONS
D Moja 305-867-3644

Special flight demonstration payloads and various types of satellite servicing equipment are being considered for space shuttle missions in the mid-1980's The proposed flight demonstration payloads include space construction experiments and cryogenic propellant transfer and storage experiments Satellite servicing equipment includes maneuverable television, proximity operations module, and teleoperator maneuvering system These flight experiments and items of special equipment will require unique planning at KSC in the areas of checkout, servicing, storage, and possibly refurbishing and reprocessing The purpose of this study is to identify special flight equipment and satellite servicing equipment, determine launch site requirements, and to recommend facilities, GSE, and operational scenarios to onset these requirements

W83-70588 **906-64-24**
John F Kennedy Space Center, Cocoa Beach, Fla
ORBITAL TRANSFER VEHICLE GROUND OPERATIONS STUDY
D Moja 305-867-3644

High energy upper stages (HEUS) hereafter called orbital transfer vehicles (OTV) concepts are being studied by NASA and the DOD The OTV is being considered to expand the STS capability in the late 1980's and 1990's OTV concepts will include expendable and reusable vehicles with round trip capability where the OTV may return empty or return with a payload to the shuttle or a space station This study will address the need for new or modified KSC facilities and GSE to handle, test, assemble and service the OTV The study will aslo address any unique requirements resulting from a reusable OTV

W83-70589 **906-65-00**
Marshall Space Flight Center, Huntsville, Ala
ADVANCED TRANSPORTATION SHUTTLE DERIVED VEHICLES (SDV)
M A Page 205-453-3425

The objectives of this effort are (1) to refine vehicle concepts and supporting facilities/equipment definition for shuttle derived vehicles, (2) to establish and incorporate mission requirements into the basic vehicles definition, and (3) to determine costs, benefits, and schedules required for implementation Contracted studies are currently in progress to define several shuttle derived vehicle concepts that could augment the basic STS in several different ways These concepts utilized current

state-of-the-art technologies and the configurations were established by trade analysis SDV concepts that are currently being investigated include SRB-X, aft-cargo carrier (ACC), shuttle derived cargo vehicles and reusable liquid rocket boosters for use with the basic STS and/or shuttle derived cargo vehicles Potential mission applications and benefits will be examined in more depth for selected vehicle concepts or classes in FY-83, along with further definition of the vehicle concept(s), its capabilities and requirements for implementation Trade studies to determine the benefits of flyback boosters, in comparison with ballistic down-range recovery approach will be made Cost and schedule estimates will be made in preparation for configuration trades and selection

W83-70590 **906-70-00**
Marshall Space Flight Center, Huntsville, Ala
TETHERED SATELLITE SYSTEM (TSS) (SYSTEM DEVELOPMENT)
J H Laue 205-453-4570

The objective of this task is to accomplish the first of a two-phase development activity leading to the design/development of a deployer system and overall system integration of the TSS The FY-83 activity will involve continuation of advanced development phase tasks including (1) systems requirements analysis (2) system/subsystem design update (3) design trade studies, (4) breadboards, and (5) phase C/D planning Phase A in-house and Phase B contracted definition studies resulted in concepts for a TSS to be used as a Shuttle-borne facility for conducting scientific experiments and applications beginning in 1989 The FY-83 activity will be performed by one of the two Phase B contractors Contractor selection will be by a competitive process and will be based on the Phase B contractor's response to a Request for Proposal (RFP) for a two phase development of the TSS This RTOP addresses the FY-83 initial, or advanced development, phase of the development The second phase, the design and development phase, is planned to begin in FY-84 and will lead to initial launch of the experimental flight TSS in early 1987 The experimental flight TSS will include engineering instrumentation and a demonstration science experiment

W83-70591 **906-75-00**
Marshall Space Flight Center, Huntsville, Ala
TELEOPERATOR MANEUVERING SYSTEM
J R Turner 205-453-2769

The objective of this effort is to provide the preliminary definition (Phase B) of the teleoperator maneuvering system (TMS) and development of planning and cost data to support the subsequent hardware design and fabrication contract In addition, this effort will include supporting development activities in the rendezvous, docking, TMS remote control and servicing system/manipulator areas Extensive in-house and contracted studies have built a sound base of potential applications for this system and have defined competing concepts of satisfying the requirements Through the day-to-day management of this follow-on definition phase, all segments of potential user interest/requirements will be factored into a set of firm requirements supported by cost and schedule data for the initiation of the follow-on hardware phase It is expected that a minimum of two contract activities will be funded and supported by in-house system trades and supporting development activities

W83-70592 **906-75-00**
Lyndon B Johnson Space Center, Houston, Tex
ORBITAL SERVICES
Richard F Baillie 713-483-2703

The shuttle mission model identifies many payload deployment and retrieval requirements beyond the capability of the basic shuttle system Satellites such as the MMS and space telescope require periodic servicing Studies of some future space systems show that longer operational lifetimes are necessary for long-duration, low-cost operation, and that a servicing capability including maintenance, repair, and refurbishment will be required Studies of possible flux densities of non-functional satellites and debris in the year 2000 time period show results indicating potential hazards to space flight It is now timely for the development of a satellite services capability for a cost-effective means of meeting early payload needs and to meet longer-term requirements for dealing with maintenance and satellite removal requirements This RTOP includes the definition, design, development, fabrication, and testing for engineering and operational verification of key elements of a satellite services system These services include deployment and retrieval of payloads, servicing of payloads, and development of techniques for handling large flexible structures

W83-70593 **906-80-00**
Lyndon B Johnson Space Center, Houston, Tex
ADVANCED CONCEPTS
Richard F Baillie 713-483-2703

Activities covered by this RTOP investigate new and promising concepts for accomplishment of function relevant to OSTS needs FY-82 activities will concentrate on understanding unique vehicle control techniques which utilize spaceborne tethers Specific Tasks for FY-83 include investigations of dynamic stability and the power/drag generator

W83-70594 **906-90-00**
Marshall Space Flight Center, Huntsville, Ala
DEPLOYABLE ANTENNA FLIGHT EXPERIMENT
Wilbur E Thompson 205-453-2796

The FY-83 objectives are to continue system integration studies of Shuttle-attached large structure/antenna flight tests to support STS capability development and planning on future space test operations This effort will augment existing preliminary designs and plans which were produced by system definition studies of a large-aperture engineering flight test and measurement program on the Orbiter Studies to date have focused on a reusable test-bed structure to provide engineering and operations data which addresses both STS requirements and user application requirements for space operations with 50-200 meter deployable systems Phase A contracted studies during FY-77 to FY-79 produced design concepts and flight test program options which allowed initiation of joint NASA/DOD studies in FY-80 to further define a flight experiment with multi-user test objectives Parallel system definition of the antenna flight test was continued in FY-81 along with initiation of hardware development for structural ground tests on the large deployable support mast FY-82/-83 studies will complete the system integration definition to support STS program planning for candidate flight test programs Also planned for FY-83 are design, fabrication and testing of ground-based components to aid design and manufacture of close-tolerance space test articles These accomplishments in FY-83 will retain a NASA, or Joint-Agency, option to implement design and development in FY-84/-85

W83-70595 **906-90-03**
Marshall Space Flight Center, Huntsville, Ala
GEOSTATIONARY PLATFORM BUS DEFINITION
W T Carey 205-453-3424

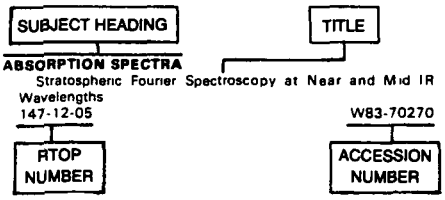
The objectives of this RTOP are to complete all pre-phase B studies for the initial (or first) geostationary platform bus and establish working relationships with government agencies and industry for a potential joint endeavor Maximum use will be made of the currently defined experimental geostationary platform bus Reference missions (e g , INTELSAT 7, Voice of America, Direct Broadcast) will be used to define various candidate configurations Preliminary designs will be developed based on user provided candidate payloads and carried to the point where the feasibility of each candidate bus configuration can be assessed Supporting programmatic data necessary to initiate Phase B will be developed Multi-purpose bus(es) that can accommodate all of the reference missions with only minor changes from one to the next will be defined Payloads which best serve to demonstrate technologies viewed as high risk by potential future commercial geostationary platform users will be given primary consideration Care shall be taken to preserve the integrity of the currently defined experimental geostationary platform which already contains technologies and systems in need of demonstration Close coordination will be developed and maintained with representatives from government agencies and industry with a view toward developing a joint endeavor for the hardware phase of the project

SUBJECT INDEX

RTOP SUMMARY

FISCAL YEAR 1983

Typical Subject Index Listing



A title is used to provide a more exact description of the subject matter. The RTOP accession number is used to locate the bibliographic citations and technical summaries in the Summary Section.

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

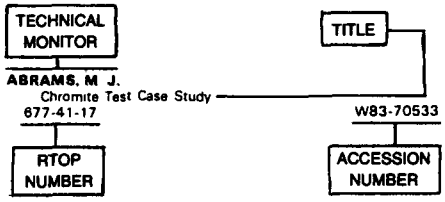
Page Intentionally Left Blank

TECHNICAL MONITOR INDEX

RTOP SUMMARY

FISCAL YEAR 1983

Typical Monitor Index Listing



A title is used to provide a more exact description of the subject matter. The RTOP accession number is used to locate the bibliographic citations and technical summaries in the Summary Section.

A

B

C

D

E

F

G

H

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y

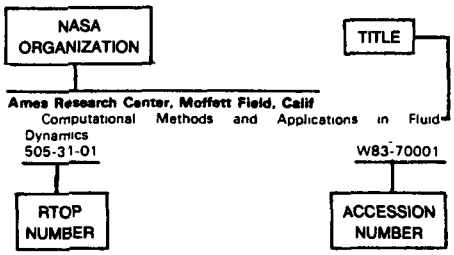
Z

RESPONSIBLE NASA ORGANIZATION INDEX

RTOP SUMMARY

FISCAL YEAR 1983

Typical Responsible NASA Organization Index Listing



Listings in this index are arranged alphabetically by Responsible NASA Organization. The title of the RTOP provides the user with a brief description of the subject matter. The accession number denotes the number by which the citation and the technical summary can be located within the Summary Section. The titles are arranged under each Responsible NASA Organization in ascending accession number order

A

Ames Research Center, Moffett Field, Calif
Computational Methods and Applications in Fluid Dynamics
505-31-01 W83-70001
Viscous Flows
505-31-11 W83-70004
Experimental/Theoretical Aerodynamics
505-31-21 W83-70007
Computational Flame Radiation Research
505-31-41 W83-70011
Test Methods and Instrumentation
505-31-51 W83-70013
Life Predicton Fatigue Damage and Environmental Effects in Metals and Composites
505-33-21 W83-70020
Fire Resistant Composites
505-33-31 W83-70023
Flight Loads Analysis
505-33-41 W83-70026
Flight Control Concepts and Reliability Enhancement
505-34-01 W83-70030
Advanced Controls and Guidance
505-34-11 W83-70033
Human Factors Facilities Operations
505-35-01 W83-70036
Flight Management Systems
505-35-21 W83-70038
Piloted Simulation Technology
505-35-31 W83-70040
Funds for Independent Research (Aeronautics)
505-36-11 W83-70042
Aeronautics Graduate Research Program
505-36-21 W83-70045
Numerical Aerodynamic Computational Techniques
505-37-01 W83-70049
Advanced Computational Concepts
505-37-21 W83-70052
Class VI Computational Capability Support
505-37-31 W83-70053
Rotorcraft Aeromechanics and Configurations
505-42-11 W83-70064
Low Speed Wind Tunnel Operations
505-42-81 W83-70067
Geodynamics/Flight Dynamics of Powered Lift Vehicles
505-43-01 W83-70068
High Performance Aircraft Flight Dynamics and Flying Qualities
505-43-11 W83-70070
Interagency Assistance and Testing - Dryden
505-43-31 W83-70074
High-Speed Wind Tunnel Operations
505-43-61 W83-70079
Hypersonic Aeronautics Technology
505-43 81 W83-70080
B-57B Flight Investigation of Environmental Hazards
505-45-01 W83-70083
Operational Problems Fireworthiness and Crashworthiness
505-45-11 W83-70088
Rotorcraft Flight Guidance Systems Technology
532-01-11 W83-70094
RSRA Flight Research/Rotors
532-03-11 W83-70095
Rotorcraft Systems Integration
532-06-11 W83-70096
Flight Experiments Support
532-07-11 W83-70099
Simulation Facilities Operations
532-08-11 W83-70100
Advanced Fighter Technology Integration/F-111 (AFTI-F-111)
533-02-11 W83-70101
Advanced Fighter Aircraft (F-15)
533-02-21 W83-70102
F-4C Spanwise Blowing Flight Investigations
533-02-31 W83-70103
Integrated Research Aircraft Control Technology (INTERACT)
533-02-41 W83-70105
Propulsive-Lift Technology - QSRA Flight Experiments
533-02-50 W83-70106
Powered Lift Systems Technology - Harrier Flight Research Program
533-02-51 W83-70107
AFTI/F-16
533-02-61 W83-70108
Decoupler Pylon Flight Evaluation
533-02-71 W83-70109
Support for Forward Swept Wing (X-29A)
533-02-81 W83-70111
Flight Support
533-02-91 W83-70113
Highly Maneuverable Aircraft Technology Flight Research
533-03-11 W83-70114
Advanced Turboprop-Installation Aerodynamics
535-03-11 W83-70121
Computational and Experimental Aerotherodynamics
506-51-11 W83-70123
Thermo-Gasdynamic Test Complex
506-51-41 W83-70126
Surface Physics and Computational Chemistry
506-53-11 W83-70127
Thermal Protection Systems Materials and Systems Evaluation
506-53-31 W83-70136
Structures Analysis and Synthesis
506-53-51 W83-70142
Photophysics and Optical Information Processing
506-54-11 W83-70147
Far Infrared Detectors and Cooled Research
506-54-21 W83-70153
Advanced Concepts for Knowledge-Based Expert Systems
506-54-61 W83-70160
Space Human Factors
506-57-21 W83-70189
Future Data Systems Concepts
506-58-11 W83-70195
Study of Large Deployable Reflector for Infrared and Submillimeter Astronomy
506-62-21 W83-70212
Infrared Imagery of Shuttle
506-63-35 W83-70222
OEX Thermal Protection Experiments
506-63-36 W83-70223
Space Shuttle Orbiter Flying Qualities Criteria (OEX)
506-63-40 W83-70226
Space Station Life Support Technology
506-64-31 W83-70239
Climate Modeling with Emphasis on Aerosols
146-10-04 W83-70249
Tropospheric Air Quality - Technology Development
146-20-10 W83-70250
Atmospheric Processes Experiments and Systems
147-10-03 W83-70265
Quantitative Infrared Spectroscopy of Minor Constituents of the Earth s Stratosphere
147-20-03 W83-70276
Stratospheric Research
147-30-02 W83-70284
Studies of the Distribution of Elements and Mineral Phases Among Meteorites
152-03-60 W83-70295
Formation Evolution and Stability of Proto-Stellar Disks
153-01-60 W83-70298
Planetary Atmospheric Composition Structure and History
154-10-80 W83-70308
Dynamics of Planetary Atmospheres
154-20-80 W83-70309
Planetary Clouds Particulates and Ices
154-30-80 W83-70311
VEGA Balloon Nephelometer Design
157-04-80 W83-70327
Theoretical Studies of Galaxies Active Galactic Nuclei and Quasi Stellar Objects
188-41-53 W83-70381
Planetary Astronomy and Supporting Laboratory Research
196-41-67 W83-70397
Detection of Other Planetary Systems
196-41-68 W83-70398
Operational Laboratory
199-10-12 W83-70406
Longitudinal Studies
199-10-22 W83-70408
Crew Health Maintenance
199-10-32 W83-70410
Cardiovascular Deconditioning
199-20-12 W83-70413
Basic Mechanisms Underlying Space Motion Sickness
199-20-22 W83-70415
Bone Alterations
199-20-32 W83-70417
Muscle Atrophy
199-20-42 W83-70419
Blood Alterations
199-20-52 W83-70421
Fluid and Electrolyte Changes
199-20-62 W83-70423
Biological Effects of Particle Radiation
199-20-72 W83-70425
Human Behavior and Performance
199-20-82 W83-70427
General biomedical Research
199-20-92 W83-70428
Developmental Biology
199-40-22 W83-70432
Biological Adaptation
199-40-32 W83-70433
Chemical Evolution
199-50-12 W83-70434
Organic Geochemistry
199-50-22 W83-70435
Origin and Evolution of Life
199-50-32 W83-70436
Solar System Environments
199-50-42 W83-70437
Life in the Universe
199-50-52 W83-70438
The Search for Extraterrestrial Intelligence
199-50-62 W83-70439
Advanced Life Support Systems
199-60-12 W83-70441
Advanced Extravehicular Systems
199-60-22 W83-70443
Food Requirements Production and Processing for CELSS
199-60-42 W83 70444
Waste Management for CELSS
199-60-52 W83-70445
Systems Management Control and Ecological Considerations for CELSS
199-60-62 W83-70446
Cosmos Flight Experiments Project
199-70-12 W83-70448
Sample Bank
199-70-32 W83-70449
Vestibular Research Facility (VRF)/Variable Gravity Research Facility (VGRF)
199-80-32 W83-70451
Long Duration Life Sciences Satellite Program Definition
199-80-42 W83 70452
Large Primate Facility
199-80-52 W83-70454
Mammalian Development Facility
199-80-62 W83-70455
Ames Research Center Initiatives
199-90-72 W83 70457
Applications Experiments Program Support
646-41-02 W83-70472
Thematic Mapper Simulator Land Resources Studies in Western Ecozones
677-21-26 W83 70515
Remote Sensing Techniques for Geobotanical Discrimination of Chromium-Bearing Rock Types
677-42-05 W83-70537
Digital Mapping of Irrigated Cropland
677-60-11 W83-70547
Remote Sensing Applications for Facility Site Selection and Waste Disposal Impact Assessment
677-60-15 W83-70548
Use of Thematic Mapper Data for Electrical Utility Transmission Corridor Analysis and Siting
677-60-19 W83-70549

G

Goddard Inst for Space Studies, New York
Research in Astrophysics at the Goddard Institute for Space Studies and Columbia University
405-02-02 W83-70465
Goddard Space Flight Center, Greenbelt, Md
Research Airport Operation
534-04-16 W83-70119
Electrically Conductive Thermal Control Coatings
506-53-26 W83-70133
Payloads Definition Methods
506-53-56 W83-70145
Acousto-Optic & Submillimeter Device Technology
506-54-16 W83-70151
Sensor Research and Technology
506-54-26 W83-70156
MPP - Systems Software R & T
506-54-56 W83-70159
Automation Research and Technology for Near-Earth Mission Operations
506-54-66 W83-70163
Advanced Power System Technology
506-55-76 W83-70181
Data Systems Research and Technology
506-58-16 W83-70198

J

Lyndon B Johnson Space Center, Houston, Tex

K

John F Kennedy Space Center, Cocoa Beach, Fla

L

Langley Research Center, Hampton, Va

Advanced Navigation Guidance and Controls Technology
505-34-13 W83-70034
AIRLAB Operations
505-34-23 W83-70035
Community Response to Noise
505-35-13 W83-70037
Crew Cockpit Interface Technology
505-35-23 W83-70039
Flight Simulation Technology
505-35-33 W83-70041
Fund for Independent Research (Aeronautics)
505-36-13 W83-70044
Graduate Program in Aeronautics
505-36-23 W83-70047
JIAFs Base Support
505-36-43 W83-70048
Computer-Aided Design
505-37-13 W83-70050
Rotorcraft Airframe Systems
505-42-23 W83-70065
High Performance Aircraft Flight Dynamics & Controls
505-43-13 W83-70071
High-Speed Aerodynamics and Propulsion Integration
505-43-23 W83-70073
Interagency and Industrial Assistance and Testing
505-43-33 W83-70076
Supersonic Aerodynamics Configurations Integration Structures & Materials Technology
505-43-43 W83-70078
High Speed (Super/Hypersonic) Technology
505-43-83 W83-70082
Aviation Safety Severe Storm Hazards
505-45-03 W83-70085
Aircraft Landing Dynamics
505-45-23 W83-70092
Aerodynamics/Propulsion Integration
505-45-43 W83-70093
Rotorcraft Vibration and Noise
532-06-13 W83-70098
F-4 Spanwise Blowing
533-02-33 W83-70104
Decoupler Pylon Flight Demonstration
533-02-73 W83-70110
Forward Swept Wing Support
533-02-83 W83-70112
Structural Integration
534-03-13 W83-70116
Advanced Transport Operating Systems
534-04-13 W83-70118
Entry Vehicle Aerothermodynamics
506-51-13 W83-70124
Detailed Aerothermal Loads
506-51-23 W83-70125
Composites for Advanced Space Systems
506-53-23 W83-70131
Thermal Protection Systems for Earth-To-Orbit STS
506-53-33 W83-70137
Advanced Space Structures
506-53-43 W83-70140
Analysis and Design
506-53-53 W83-70143
Solid State & Optical Device Research
506-54-13 W83-70149
High Resolution Laser Research
506-54-23 W83-70154
Automation Systems Research
506-54-63 W83-70161
Advanced Radiant Energy Conversion
506-55-13 W83-70166
Solar Cell Research
506-55-43 W83-70171
Spacecraft Controls and Guidance
506-57-13 W83-70185
Manned Control of Remote Operations
506-57-23 W83-70190
Data Systems Research and Technology
506-58-13 W83-70196
Multiple Beam Antenna Technology Development Program for Large Aperture Deployable Reflectors
506-58-23 W83-70201
Advanced Large Spacecraft Systems Analysis
506-62-23 W83-70213
Technology Requirements for Advanced Space Transportation Systems
506-63-23 W83-70216
Shuttle Entry Air Data System (SEADS)
506-63-32 W83-70220
Shuttle Infrared Leeside Temperature Sensing (SILTS)
506-63-34 W83-70221
Shuttle Upper Atmosphere Mass Spectrometer (SUMS)
506-63-37 W83-70224
High Resolution Accelerometer Package (HiRAP) Experiment Development
506-63-43 W83-70228
Technology Systems Analysis Across Disciplines for Permanently Orbiting Space Stations
506-64-13 W83-70230
Teleoperator and Robotics System Analysis
506-64-23 W83-70234
FILE Flight Experiments--Analysis and Support
542-03-14 W83-70243
Crystal Growth in Space
542-03-30 W83-70246
Low Duration Exposure Facility
542-04-13 W83-70247
Meteorological Lidar Development
146-74-01 W83-70263
Crystal Growth Research
179-80-70 W83-70369
Radiation Effects and Protection
199-20-76 W83-70426
Biosphere-Atmosphere Interactions in Wetland Ecosystems
199-30-36 W83-70431
System Analysis and Evaluation of Permanently Manned Orbiting Space Facilities
906-54-20 W83-70579

Lewis Research Center, Cleveland, Ohio
Computational Fluid Dynamics for Turbomachinery
505-31-02 W83-70002
Fluid Mechanics of Turbomachinery/Lewis
505-31-32 W83-70009
Burning Fundamentals & Heat Transfer
505-31-42 W83-70012
Propulsion Instrumentation
505-31-52 W83-70014
High Temperature Materials
505-33-12 W83-70018
Life Prediction for Engine Materials
505-33-22 W83-70021
High Temperature Engine Composites
505-33-32 W83-70024
Engine Dynamics and Aeroelasticity
505-33-42 W83-70027
Control Theory and Methodology
505-34-02 W83-70031
Fund for Independent Research (Aeronautics)
505-36-12 W83-70043
Graduate Program in Aeronautics
505-36-22 W83-70046
Computational Facilities
505-37-32 W83-70054
Inlets and Nozzles
505-40-02 W83-70055
Fan and Compressor Research
505-40-12 W83-70056
Combustors and Turbines
505-40-22 W83-70057
Propeller Research
505-40-32 W83-70058
Power Transfer Research
505-40-42 W83-70059
Controls and Instrumentation
505-40-52 W83-70060
Engine Systems Research
505-40-62 W83-70061
Engine Systems Facilities Operations
505-40-70 W83-70062
Wind Tunnel Operations
505-40-72 W83-70063
Rotorcraft-Operating Problems
505-42-32 W83-70066
Powered Lift Propulsion Technology
505-43-02 W83-70069
Non-Axisymmetric Nozzle Research
505-43-22 W83-70072
Interagency & Industrial Assistance & Testing
505-43-32 W83-70075
Supersonic Propulsion Integration Technology
505-43-42 W83-70077
Hypersonic Propulsion Integration Technology
505-43-82 W83-70081
Aircraft Icing Research
505-45-02 W83-70084
Aircraft Fuel Efficiency Improvement
505-45-22 W83-70091
Convertible Engine System Technology
532-06-12 W83-70097
Turbine Engine Hot Section Technology (HOST)
533-04-12 W83-70115
Energy Efficient Engine Project
535-01-12 W83-70120
Advanced Turboprop Program
535-03-12 W83-70122
Non-Destructive Evaluation and Tribology
506-53-12 W83-70128
Submillimeter & Optical Processing Device Research
506-54-12 W83-70148
Advanced Concepts in Energy Conversion
506-55-12 W83-70165
Electric Propulsion Technology
506-55-22 W83-70168
Photovoltaic Research and Technology
506-55-42 W83-70170
Electrochemical Energy Conversion and Storage
506-55-52 W83-70174
Power Systems Management and Distribution
506-55-72 W83-70179
Satellite Communications Research and Technology
506-58-22 W83-70200
Earth-to-Orbit Propulsion Life and Performance Technology
506-60-12 W83-70206
Variable Thrust OTV Propulsion Technology
506-60-42 W83-70210
Space Station Propulsion Requirements
506-64-12 W83-70229
Platform Systems Operations
506-64-22 W83-70233
Flight Test of an Ion Auxiliary Propulsion System (IAPS)
542-05-12 W83-70248
Reduced Gravity Combustion Science
179-80-51 W83-70366
Technical Consultation Services
643-10-01 W83-70466
New Application Studies
643-10-02 W83-70468
Experiment Coordination and Mission Support
646-41-01 W83-70471
Space Communications Systems Antenna Technology
650-60-20 W83-70474
Satellite Switching and Processing Systems
650-60-21 W83-70475
RF Components for Satellite Communications Systems
650-60-22 W83-70476
Communications Laboratory for Transponder Development and Satellite Network Evaluation
650-60-23 W83-70477
Advanced Communications Technology Satellite (ACTS) System Studies
650-60-26 W83-70478

M

Marshall Space Flight Center, Huntsville, Ala
Safety - Atmospheric Processes
505-45-09 W83-70087
Space Durable Composites and Thermal Control Surfaces
506-53-29 W83-70135
Space Vehicle Structural Dynamic Analysis and Synthesis Methods
506-53-59 W83-70146
Multi-KW Solar Arrays
506-55-49 W83-70173
Multi-100 kW Low Cost Earth Orbital Systems
506-55-79 W83-70183
Large Space Systems Technology Control and Guidance
506-57-19 W83-70188
Teleoperator and EVA Human Factors
506-57-29 W83-70193
On-line Data Ingest/Staging System
506-58-19 W83-70199
Reusable High Pressure Main Engine Technology
506-60-19 W83-70208
OTV Propulsion Performance and Plume Characterization
506-60-49 W83-70211
Solar Array Flight Experiment (SAFE) Dynamics & Control *Augmentation* (Flights 1 and 2)
506-62-49 W83-70215
Conceptual Characterization and Technology Assessment
506-63-29 W83-70218
Platform Systems Study
506-64-19 W83-70232
Teleoperations and Cryogenic Fluid Management
506-64-29 W83-70238
Shuttle Operational Flight Test of a Large Solar Array
542-03-04 W83-70242
Tribological Experiments in Zero Gravity
542-03-27 W83-70245
Meteorological Satellite Data Research and Applications
146-61-00 W83-70252
Meteorological Observing System Development
146-73-00 W83-70262
Studies of Dynamics of Atmospheric Flows
146-76-00 W83-70264
Orbiting VLBI Feasibility Study
159-41-03 W83-70330
Advanced X-Ray Astrophysics Facility (AXAF)
159-46-01 W83-70331
Development of New Remote Data Interpretation Techniques
175-20-00 W83-70347
Remote Sensor Development
175-40-00 W83-70348
MPS AR&DA Support
179-40-62 W83-70360
Commercial Materials Processing in Low-Gravity
179-60-62 W83-70362
Cloud Physics
179-75-10 W83-70363
Containerless Processing
179-80-30 W83-70364
Bioseparation Processes
179-80-40 W83-70365
Solidification Processes
179-80-60 W83-70367
Crystal Growth Processes
179-80-70 W83-70368
Development of Experiments and Hardware for Solar Physics Research
188-38-51 W83-70370
Ground-Based Observations of the Sun
188-38-52 W83-70373
Structure and evolution of Solar Magnetic Fields (Laboratory & Theory for Solar Physics)
188-38-53 W83-70375
Ground-Based Observations UV and Optical Astronomy
188-41-21 W83-70377
Gamma Ray Astronomy and Related Research
188-46-57 W83-70384
X-Ray Astronomy
188-46-59 W83-70388
Advanced Mission Study - Solar X-Ray Pinhole Satellite and Long Focal Length Coronagraph
188-78-38 W83-70391
Gravity Probe - B
188-78-41 W83-70392
Life Sciences Payload Accommodations
199-80-48 W83-70453
Space Plasma Data Analysis
385-36-01 W83-70458
Data Analysis
385-38-01 W83-70459
Mass Storage Network R&D
656-42-01 W83-70483
Superconducting Gravity Gradiometer
676-59-33 W83-70511
Shuttle Time and Frequency Transfer Experiment (STIFT)
676-59-41 W83-70512
Space Platform Specification Development
906-50-00 W83-70577
Structural Assembly Demonstration Experiment (SADE)
906-55-00 W83-70580
Manned Facilities (Space Station)
906-58-00 W83-70581

N

Page Intentionally Left Blank

RTOP NUMBER INDEX

Typical RTOP Number Index Listing

This section may be used to identify the RTOP accession number of reports covered in this journal. Thus this section of this index may be used to locate the bibliographic citations and technical summaries in the Summary Section. The RTOP numbers are listed in ascending number order.

146-10-04	W83-70249
146-20-10	W83-70250
146-60-00	W83-70251
146-61-00	W83-70252
146-64-00	W83-70253
146-65-00	W83-70254
146-66-01	W83-70255
146-70-00	W83-70256
146-71-00	W83-70257
146-72-01	W83-70258
146-72-02	W83-70259
146-72-04	W83-70260
146-72-05	W83-70261
146-73-00	W83-70262
146-74-01	W83-70263
146-76-00	W83-70264
147-10-03	W83-70265
147-11-00	W83-70266
147-11-04	W83-70267
147-11-05	W83-70268
147-12-00	W83-70269
147-12-05	W83-70270
147-12-06	W83-70271
147-12-08	W83-70272
147-15-00	W83-70273
147-16-01	W83-70274
147-18-02	W83-70275
147-20-03	W83-70276
147-21-00	W83-70277
147-21-03	W83-70278
147-22-01	W83-70279
147-23-00	W83-70280
147-23-08	W83-70281
147-23-09	W83-70282
147-23-10	W83-70283
147-30-02	W83-70284
147-31-00	W83-70285
147-32-00	W83-70286
147-41-00	W83-70287
147-43-00	W83-70288
147-44-00	W83-70289
147-51-00	W83-70290
147-51-02	W83-70291
151-01-70	W83-70292
152-01-40	W83-70293
152-02-40	W83-70294
152-03-60	W83-70295
152-04-40	W83-70296
152-05-40	W83-70297
153-01-60	W83-70298
153-02-40	W83-70299
153-02-70	W83-70300
153-03-50	W83-70301
153-06-40	W83-70302
153-07-40	W83-70303
153-08-40	W83-70304
153-08-50	W83-70305
153-09-40	W83-70306
153-10-40	W83-70307
154-10-80	W83-70308
154-20-80	W83-70309
	W83-70310
154-30-80	W83-70311
154-40-80	W83-70312
154-50-80	W83-70313
154-60-80	W83-70314
154-75-80	W83-70315
154-80-80	W83-70316
	W83-70317
156-02-02	W83-70318
156-03-01	W83-70319
156-03-02	W83-70320
156-03-03	W83-70321
156-03-04	W83-70322
156-03-07	W83-70323
157-03-50	W83-70324
157-04-80	W83-70325
	W83-70326
	W83-70327
157-05-50	W83-70328
157-20-70	W83-70329
159-41-03	W83-70330
159-46-01	W83-70331
161-10-00	W83-70332
161-10-01	W83-70333
161-10-03	W83-70334
161-20-00	W83-70335
161-20-07	W83-70336
161-20-10	W83-70337
161-20-11	W83-70338
161-30-00	W83-70339
161-30-01	W83-70340
161-30-05	W83-70341
161-40-00	W83-70342
161-40-02	W83-70343
161-50-00	W83-70344
161-50-02	W83-70345
175-13-00	W83-70346
175-20-00	W83-70347
175-40-00	W83-70348
176-10-00	W83-70349
	W83-70350
176-30-01	W83-70351
176-40-03	W83-70352
179-11-20	W83-70353
179-13-72	W83-70354
179-15-20	W83-70355
179-20-55	W83-70356
179-20-56	W83-70357
179-20-57	W83-70358
179-40-62	W83-70359
	W83-70360
179-46-20	W83-70361
179-60-62	W83-70362
179-75-10	W83-70363
179-80-30	W83-70364
179-80-40	W83-70365
179-80-51	W83-70366
179-80-60	W83-70367
179-80-70	W83-70368
	W83-70369
188-38-51	W83-70370
	W83-70371
	W83-70372
188-38-52	W83-70373
	W83-70374
188-38-53	W83-70375
	W83-70376
188-41-21	W83-70377
188-41-22	W83-70378
188-41-24	W83-70379
188-41-51	W83-70380
188-41-53	W83-70381
188-41-55	W83-70382
188-46-56	W83-70383
188-46-57	W83-70384
	W83-70385
	W83-70386
188-46-59	W83-70387
	W83-70388
	W83-70389
188-78-38	W83-70390
	W83-70391
188-78-41	W83-70392
188-78-51	W83-70393
196-41-50	W83-70394
196-41-52	W83-70395
196-41-54	W83-70396
196-41-67	W83-70397
196-41-68	W83-70398
196-41-71	W83-70399
196-41-73	W83-70400
196-41-75	W83-70401
196-41-76	W83-70402
196-41-77	W83-70403
199-10-00	W83-70404
199-10-11	W83-70405
199-10-12	W83-70406
199-10-21	W83-70407
199-10-22	W83-70408
199-10-31	W83-70409
199-10-32	W83-70410
199-10-41	W83-70411
199-20-11	W83-70412
199-20-12	W83-70413
199-20-21	W83-70414
199-20-22	W83-70415
199-20-31	W83-70416
199-20-32	W83-70417
199-20-41	W83-70418
199-20-42	W83-70419
199-20-51	W83-70420
199-20-52	W83-70421
199-20-61	W83-70422
199-20-62	W83-70423
199-20-71	W83-70424
199-20-72	W83-70425
199-20-76	W83-70426
199-20-82	W83-70427
199-20-92	W83-70428
199-30-07	W83-70429
199-30-31	W83-70430
199-30-36	W83-70431
199-40-22	W83-70432
199-40-32	W83-70433
199-50-12	W83-70434
199-50-22	W83-70435
199-50-32	W83-70436
199-50-42	W83-70437
199-50-52	W83-70438
199-50-62	W83-70439
199-60-11	W83-70440
199-60-12	W83-70441
199-60-21	W83-70442
199-60-22	W83-70443
199-60-42	W83-70444
199-60-52	W83-70445
199-60-62	W83-70446
199-60-71	W83-70447
199-70-12	W83-70448
199-70-32	W83-70449
199-80-31	W83-70450
199-80-32	W83-70451
199-80-42	W83-70452
199-80-48	W83-70453
199-80-52	W83-70454
199-80-62	W83-70455
199-90-71	W83-70456
199-90-72	W83-70457
310-10-23	W83-70554
310-10-26	W83-70555
310-10-42	W83-70556
310-10-60	W83-70557
310-10-62	W83-70558
310-10-63	W83-70559
310-20-33	W83-70560
310-20-38	W83-70561
310-20-39	W83-70562
310-20-46	W83-70563
310-20-64	W83-70564
310-20-65	W83-70565
310-20-66	W83-70566
310-20-67	W83-70567
310-20-68	W83-70568
310-30-69	W83-70569
310-30-70	W83-70570
310-40 26	W83-70571
310-40-37	W83-70572
310-40-45	W83-70573
310-40-46	W83-70574
310-40-49	W83-70575
310-40-72	W83-70576
385-36-01	W83-70458
385-38 01	W83-70459
	W83-70460
	W83-70461
385-41-01	W83-70462
	W83-70463
385-46-01	W83-70464
405-02-02	W83-70465
505-31-01	W83-70001
505-31-02	W83-70002
505-31-03	W83-70003
505-31 11	W83-70004
505-31 13	W83-70005
505-31-15	W83-70006
505-31-21	W83-70007
505-31-23	W83-70008
505-31-32	W83-70009
505-31-33	W83-70010
505-31-41	W83-70011
505-31 42	W83-70012
505-31-51	W83-70013
505-31-52	W83-70014
505-31-53	W83-70015
505-31-83	W83-70016
505-33-10	W83-70017
505-33-12	W83-70018
505-33-13	W83-70019
505-33-21	W83-70020
505-33-22	W83-70021
505-33-23	W83-70022
505-33-31	W83-70023
505-33-32	W83-70024
505-33-33	W83-70025
505-33-41	W83-70026
505-33-42	W83-70027
505-33-43	W83-70028
505-33-53	W83-70029

10 1 RTOP, 830127 S10333ASR850609
NASA
SCIEN & TECH INFO FACILITY
ATTN: DOCUMENT SUPPLY-CLASSIFIED
P O BOX 8757 BWI ARPRT
BALTIMORE MD 21240